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Shinoura et al.

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(45) **Date of Patent: *Jul. 23, 2002**

(54) **SWITCH FOR HIGH FREQUENCY**

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(73) Assignee: **Omron Corporation**, Kyoto (JP)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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PCT Pub. Date: **Feb. 19, 1998**

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(51) **Int. Cl.**[7] **H01H 51/22**
(52) **U.S. Cl.** **335/78**; 335/80; 335/83
(58) **Field of Search** 335/78–86, 124, 335/128

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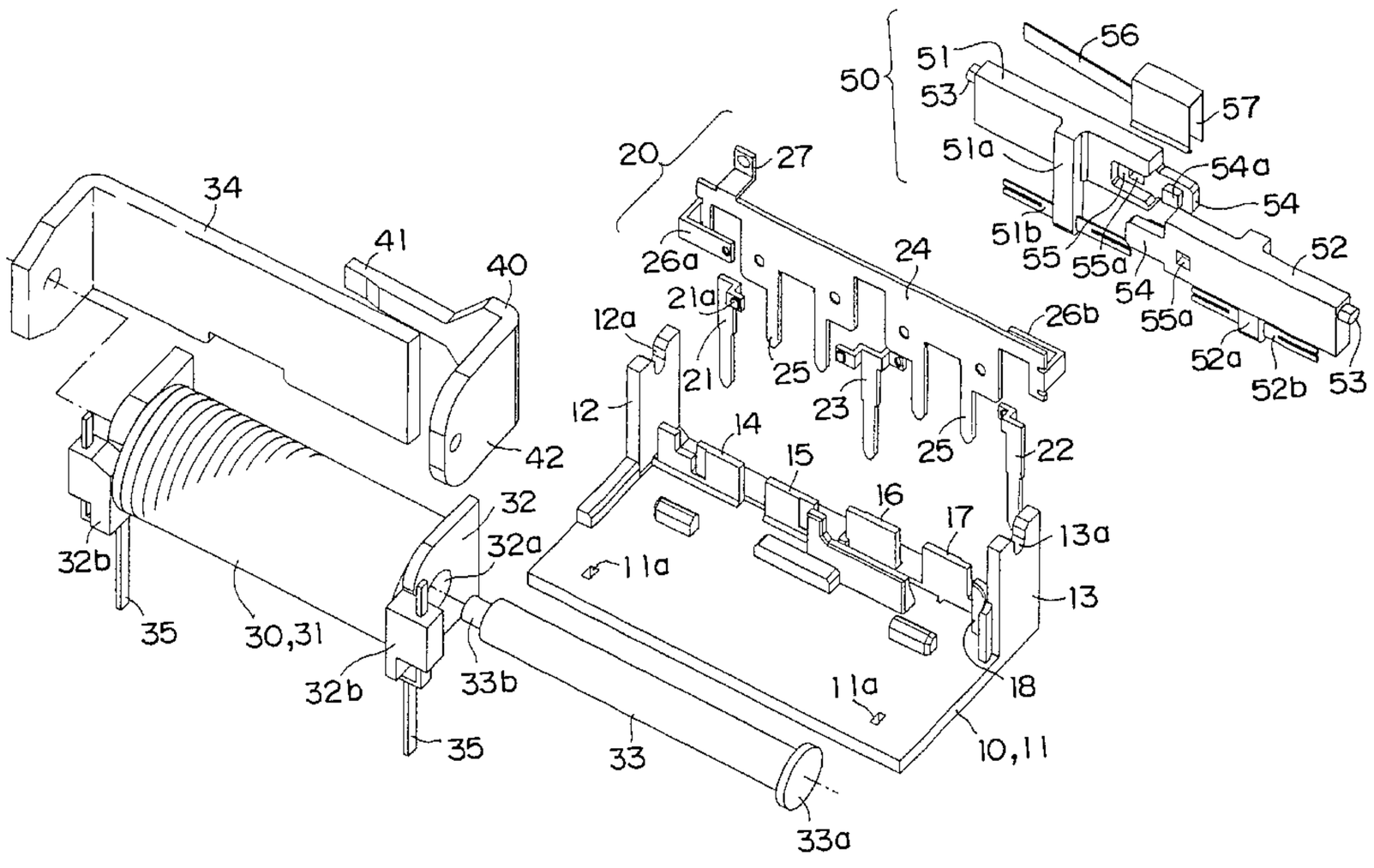
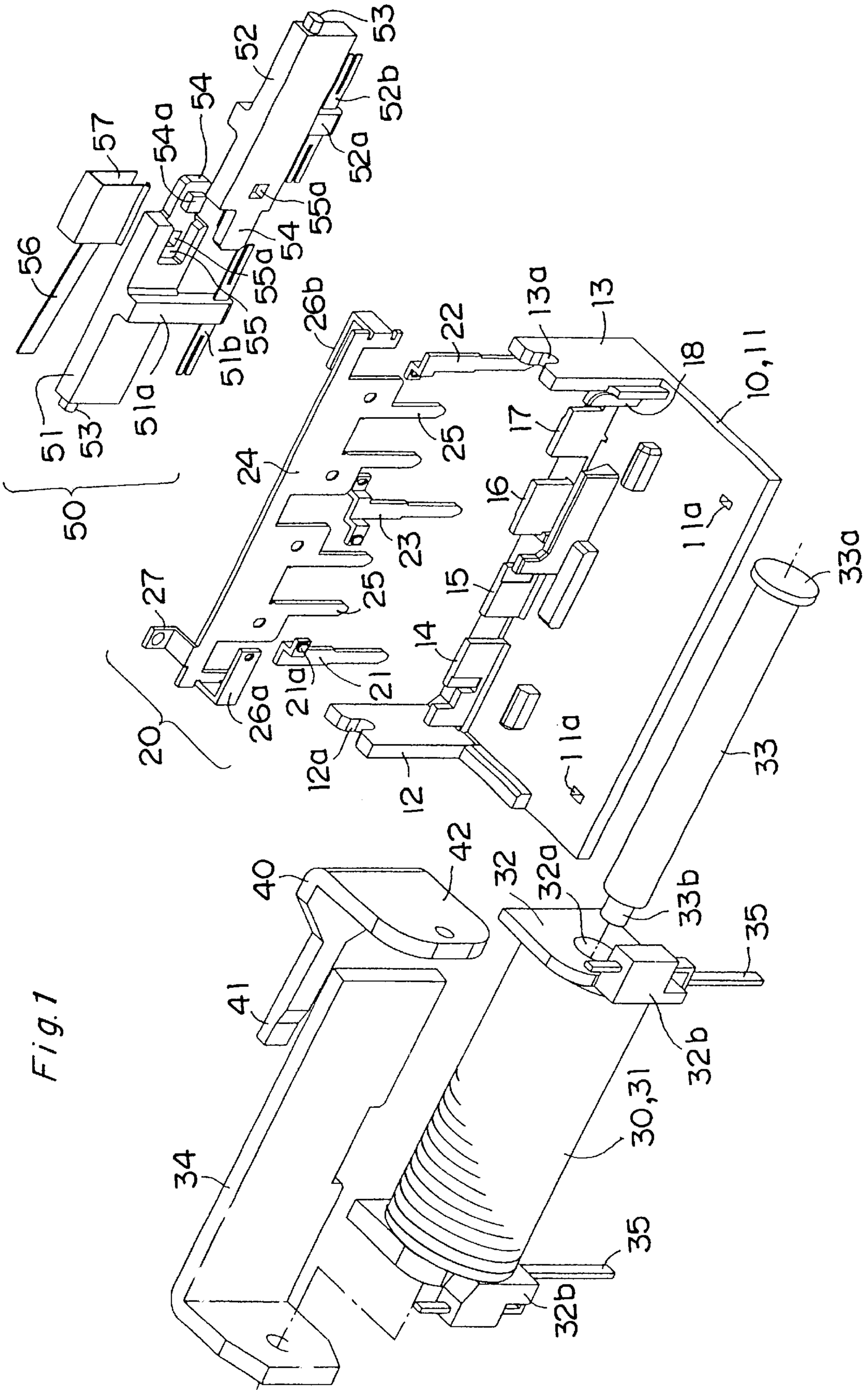
(74) *Attorney, Agent, or Firm*—Morrison & Foerster LLP

(57) **ABSTRACT**

Insulating walls **14** and **15** are arranged between fixed contacts **21***a* and **23***a* that face a movable contactor **51***b* while being able to come in and out of contact with it and a shield plate **24** positioned on the back surface side of the fixed contacts **21***a* and **23***a*. With this arrangement, a compact high-frequency use switch having the desired high-frequency characteristic can be obtained with high productivity.

11 Claims, 35 Drawing Sheets

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10,11
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51a
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23
11a
33a
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21a
21
26a
20
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35
41
32b
30,31
34
35
32b

Fig. 1

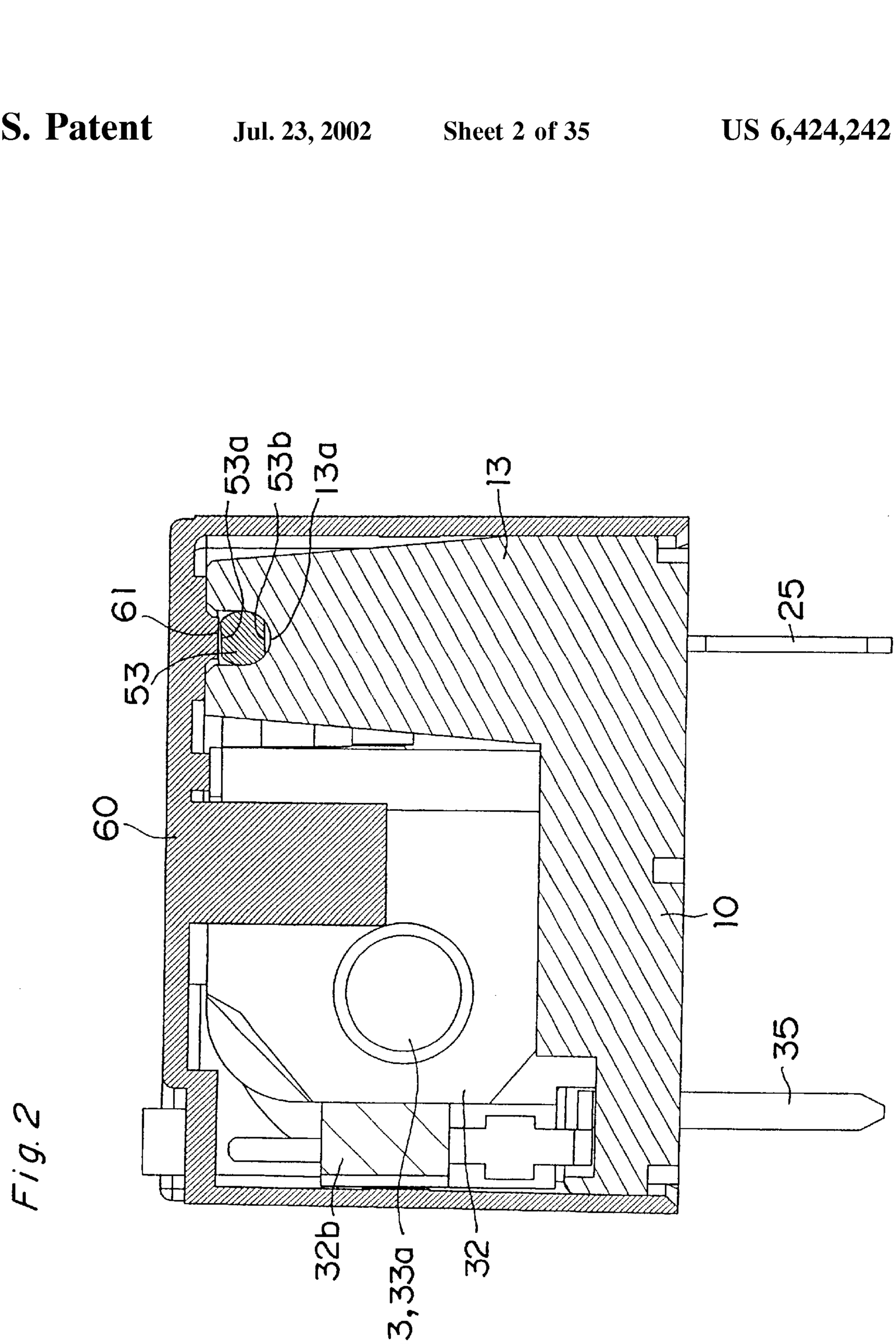
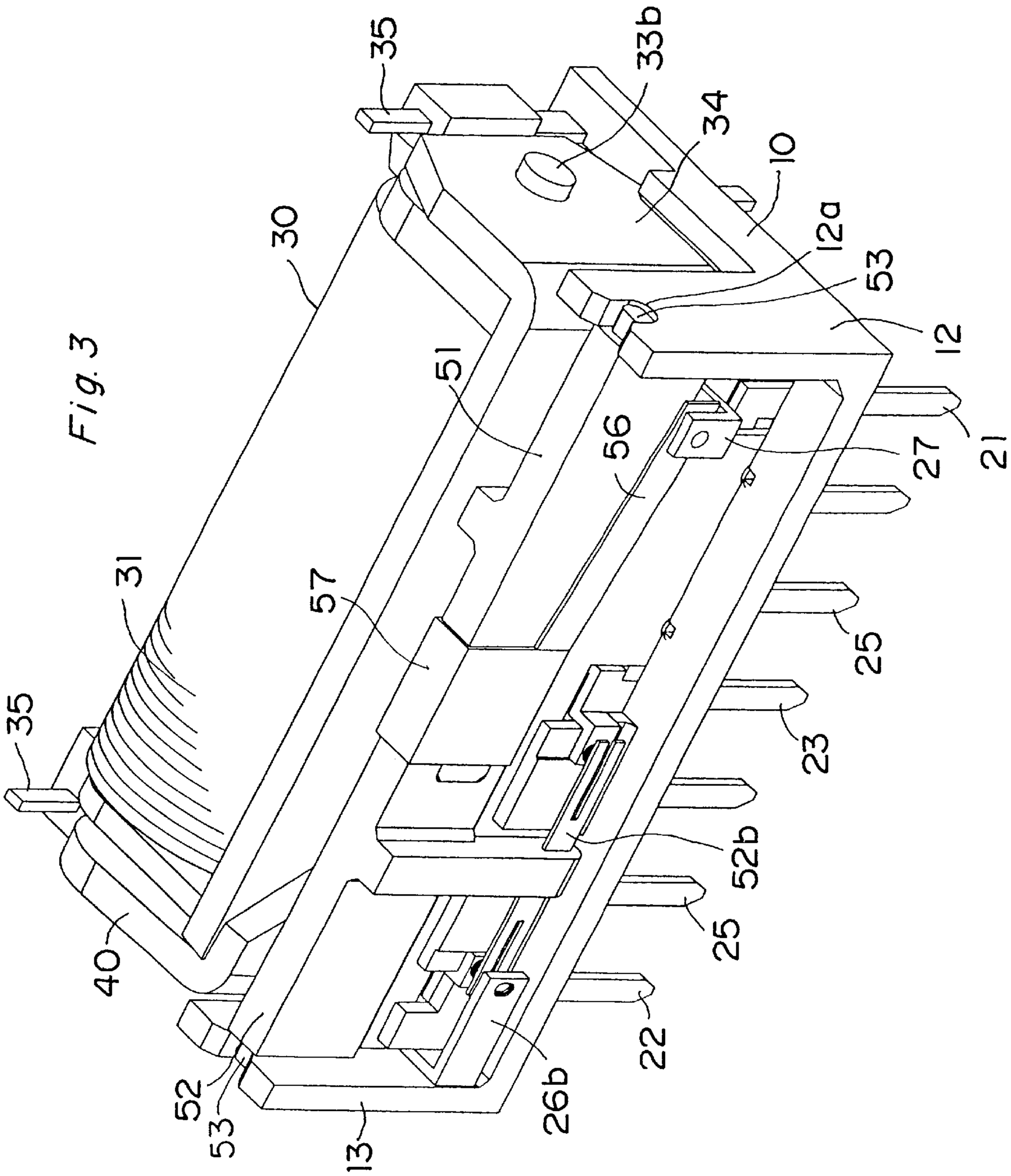


Fig. 2

Fig. 3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33b
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10
30
12a
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51
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21
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52b
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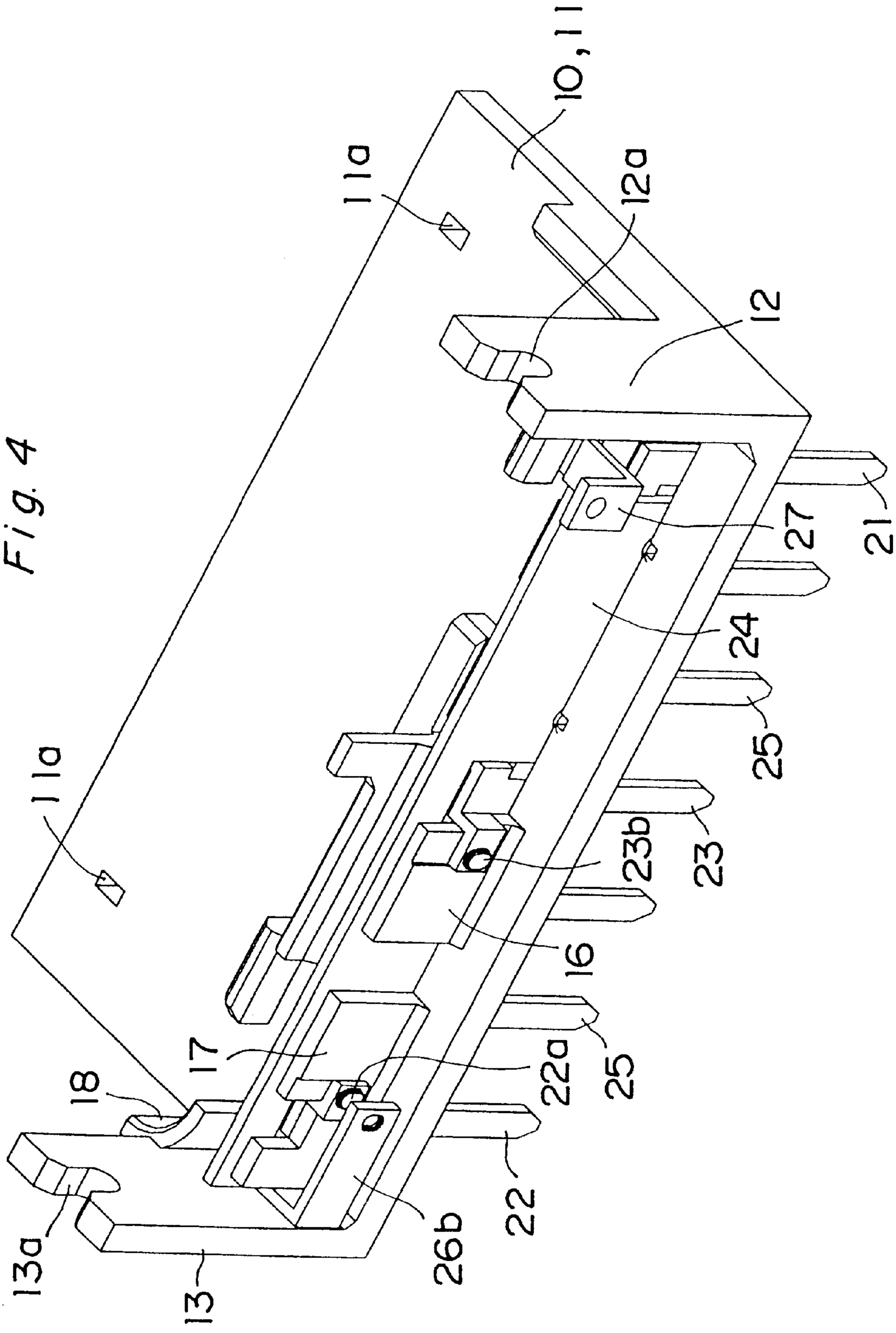
25
22
52
53
13
26b



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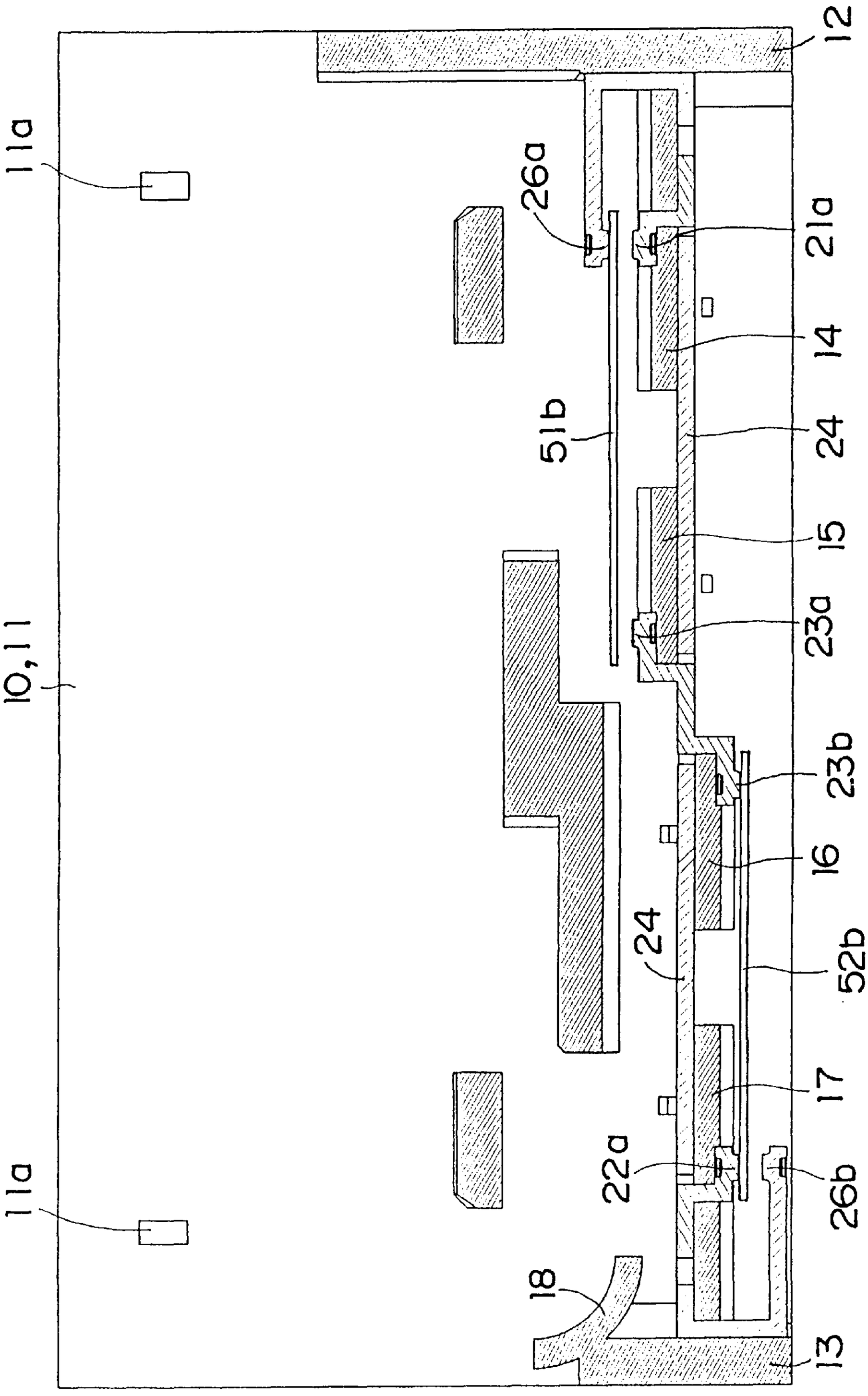

12
11a
26a
21a
14
51b
24
15
23a
10,11
23b
16
24
52b
17
22a
26b
18
13
11a

Fig. 5

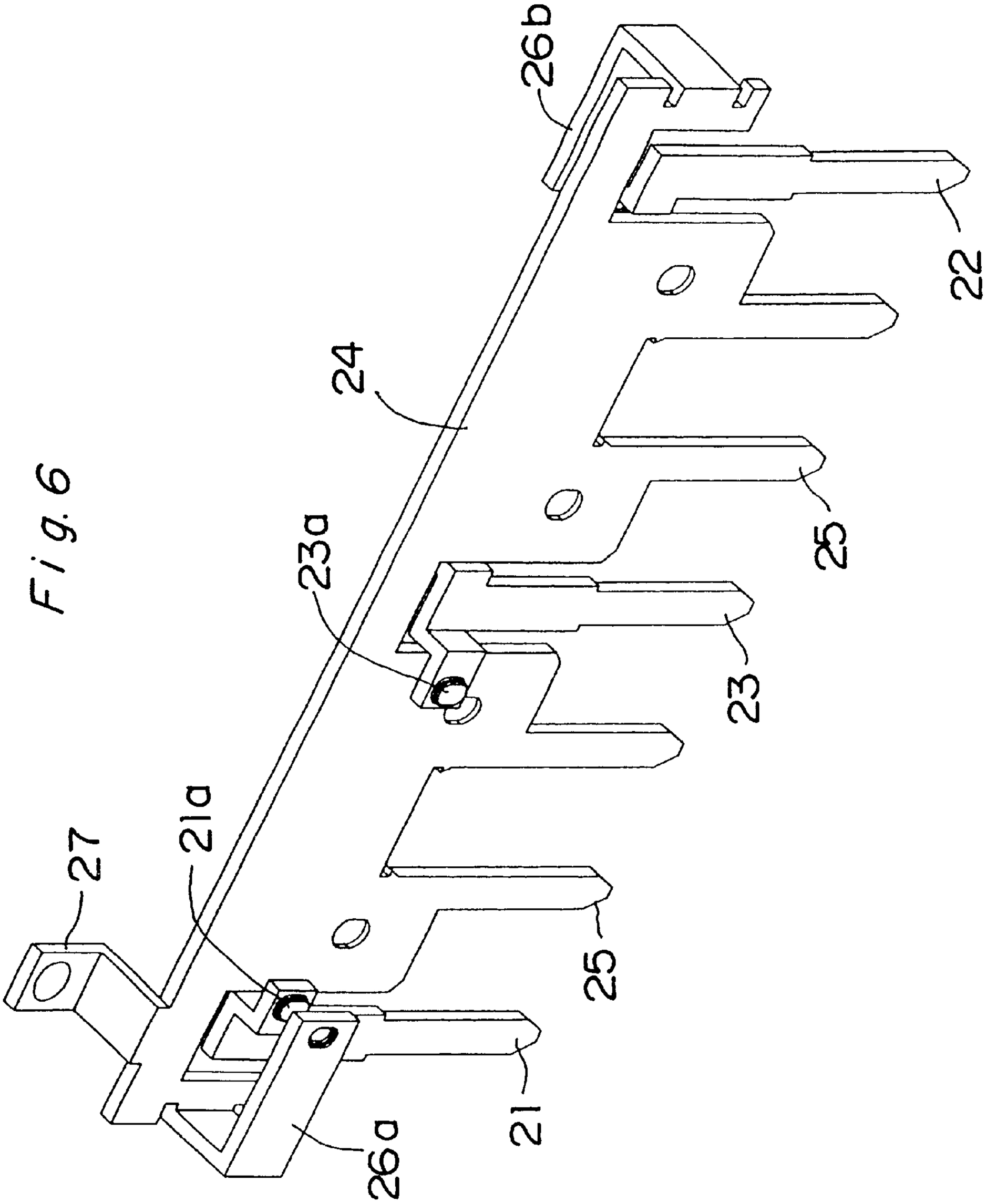


Fig. 6

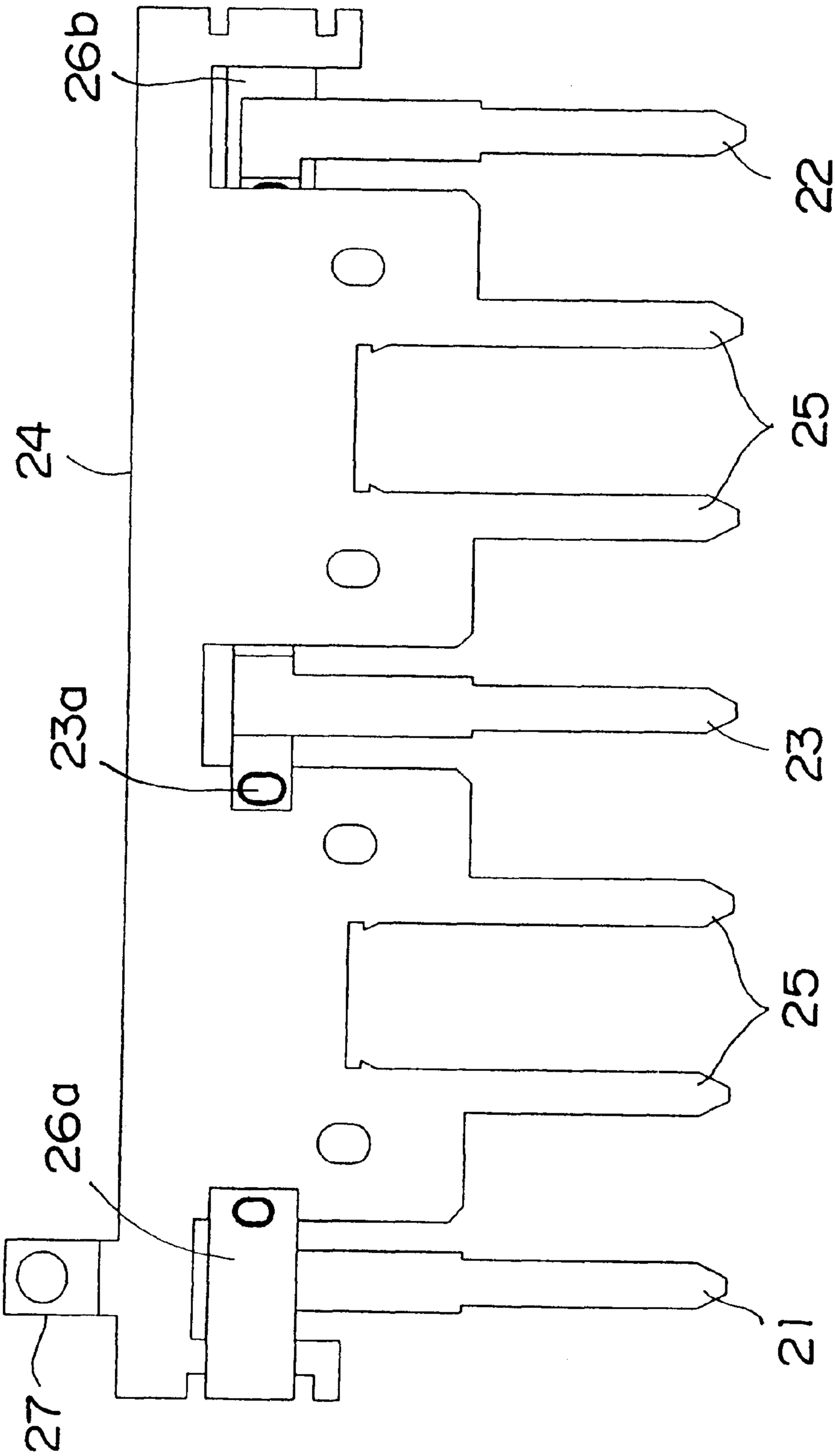
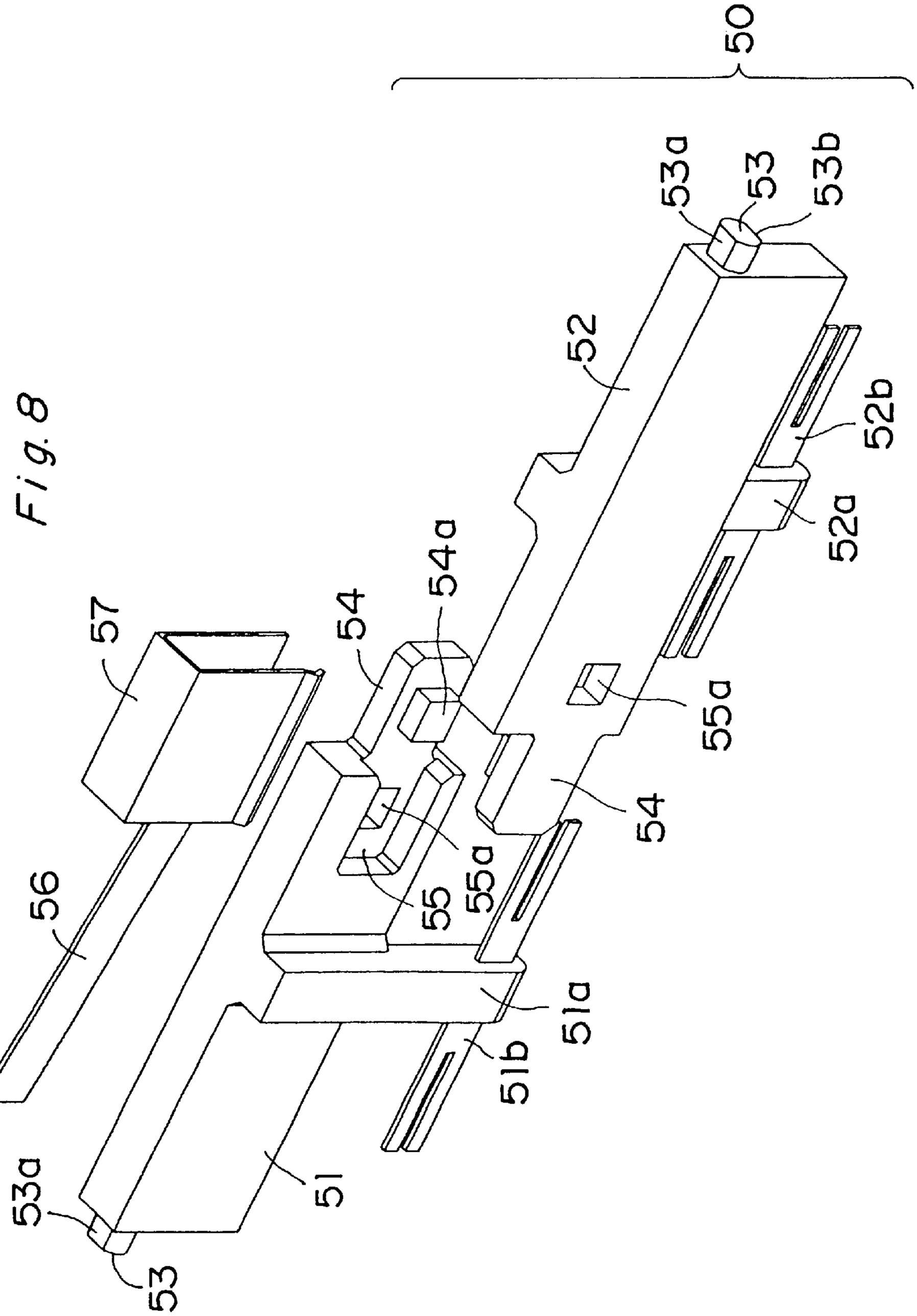


Fig. 7

Fig. 8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53a
53
53b
52
52b
52a
54a
54
57
54
55a
54
56
55
55a
51a
51b
51
53a
53

Fig. 9A

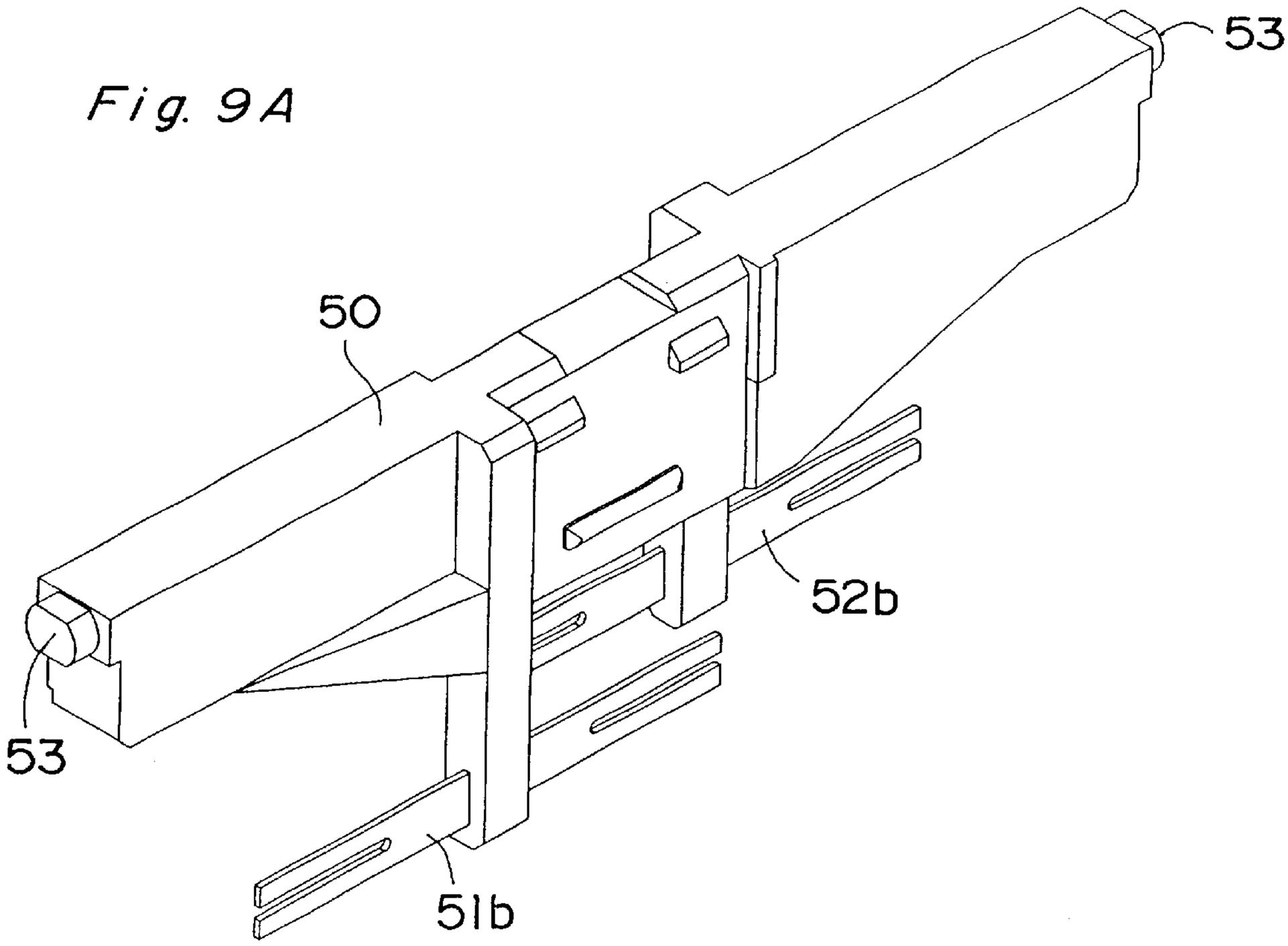


Fig. 9B

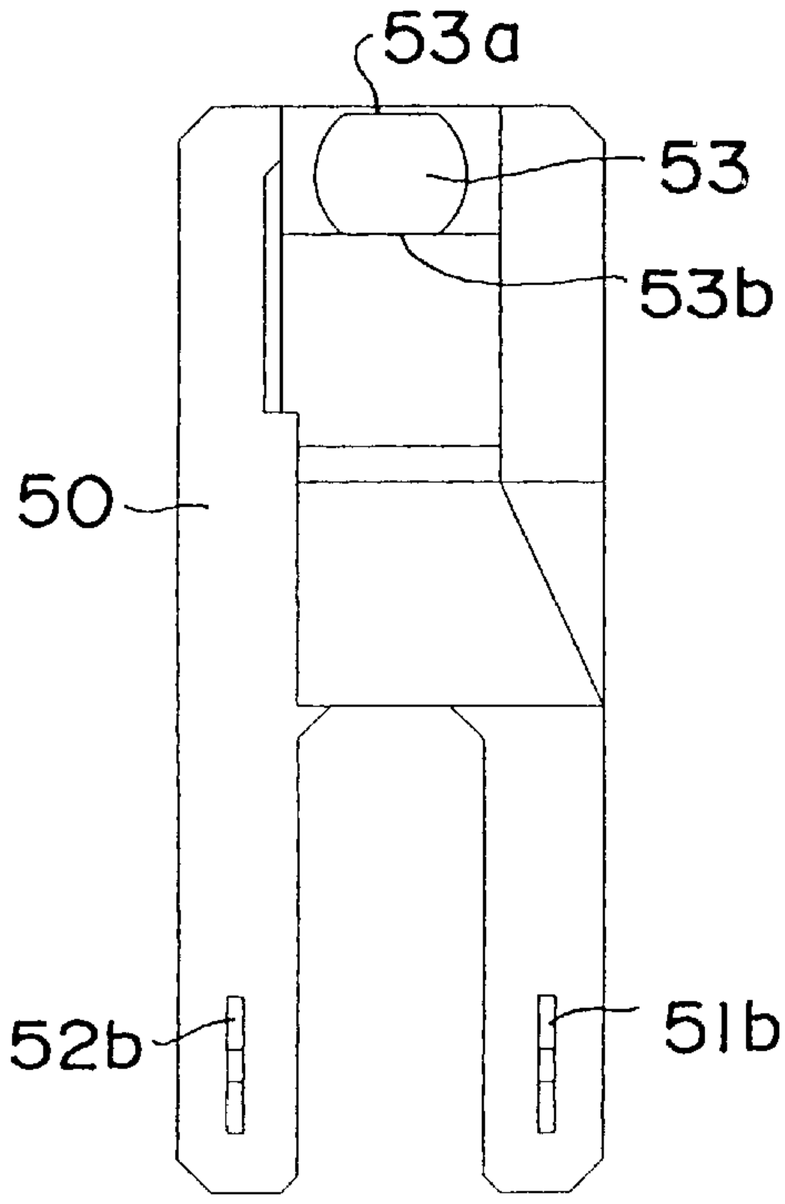
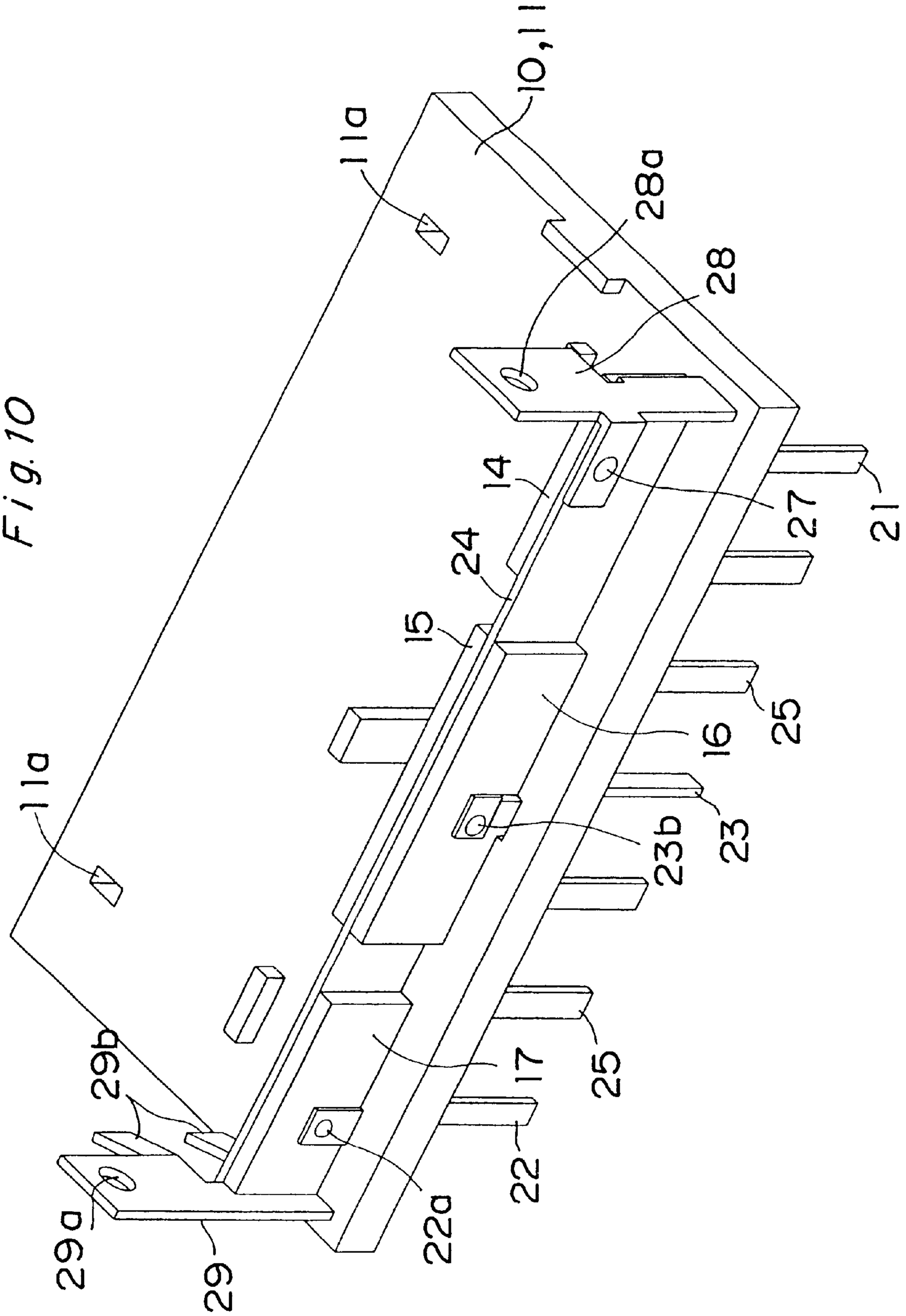


Fig. 10


11'a
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11'
28a
28
14
24
27
21
15
16
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23b
23
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22
22a
11a
29b
29a
29

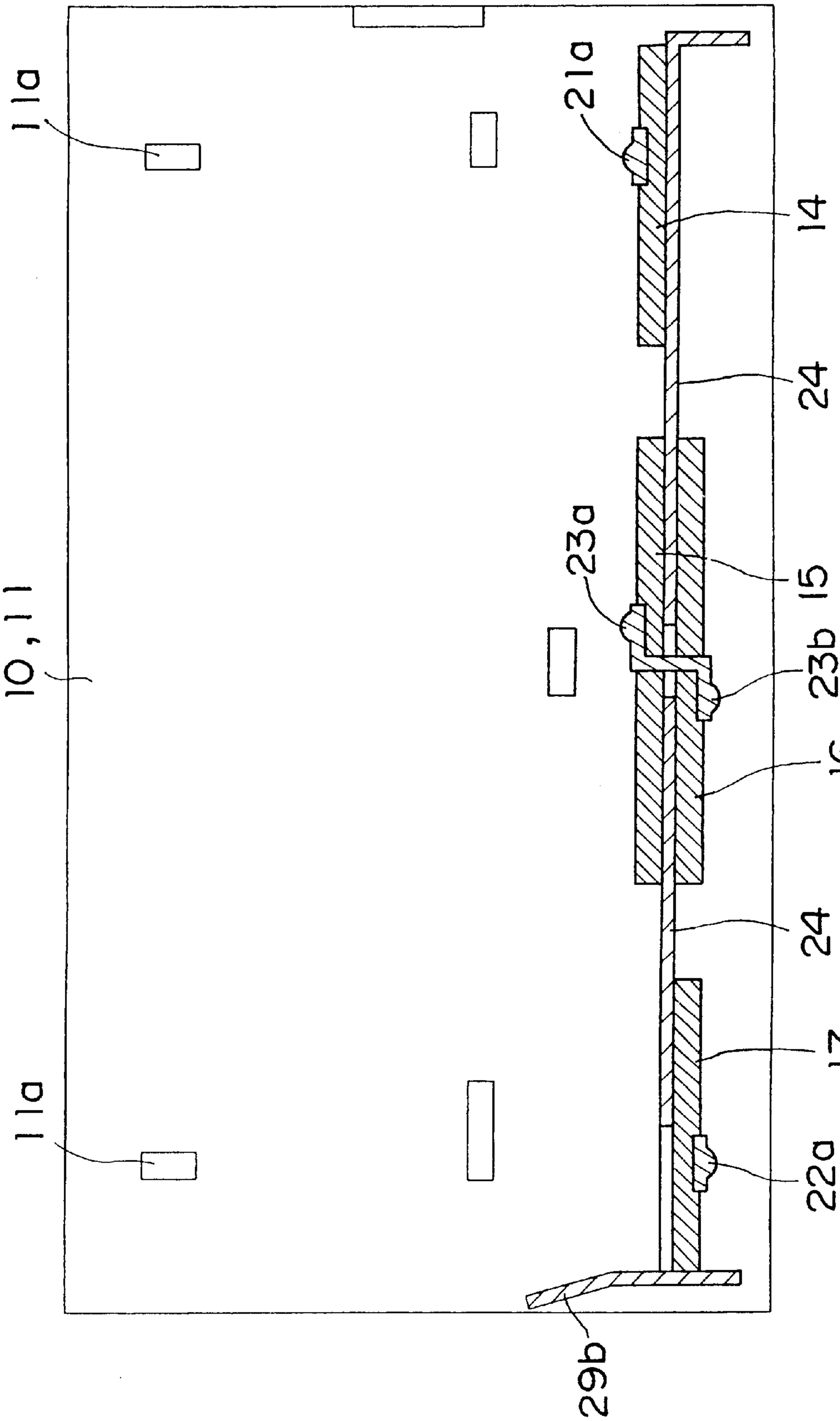
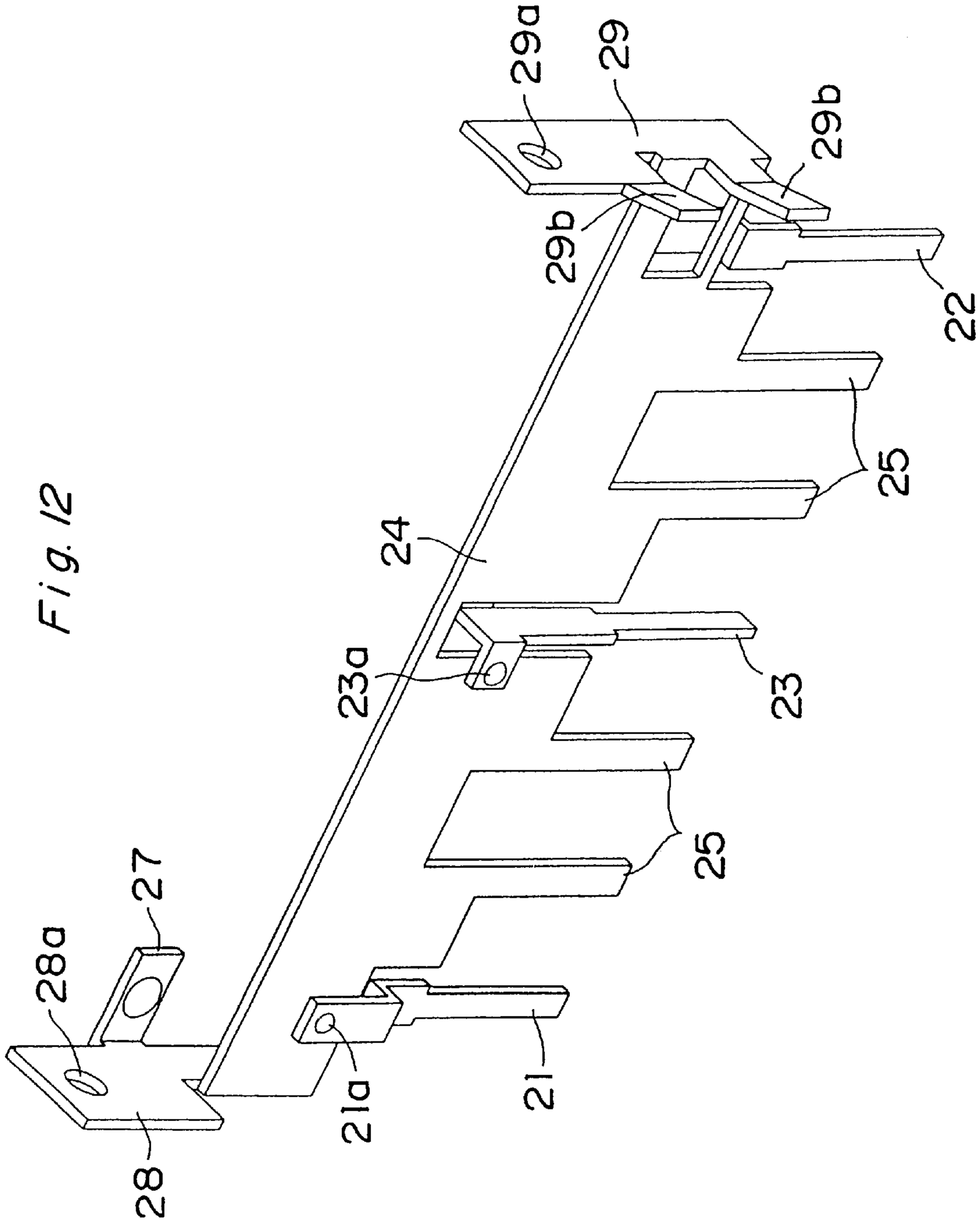


Fig.11



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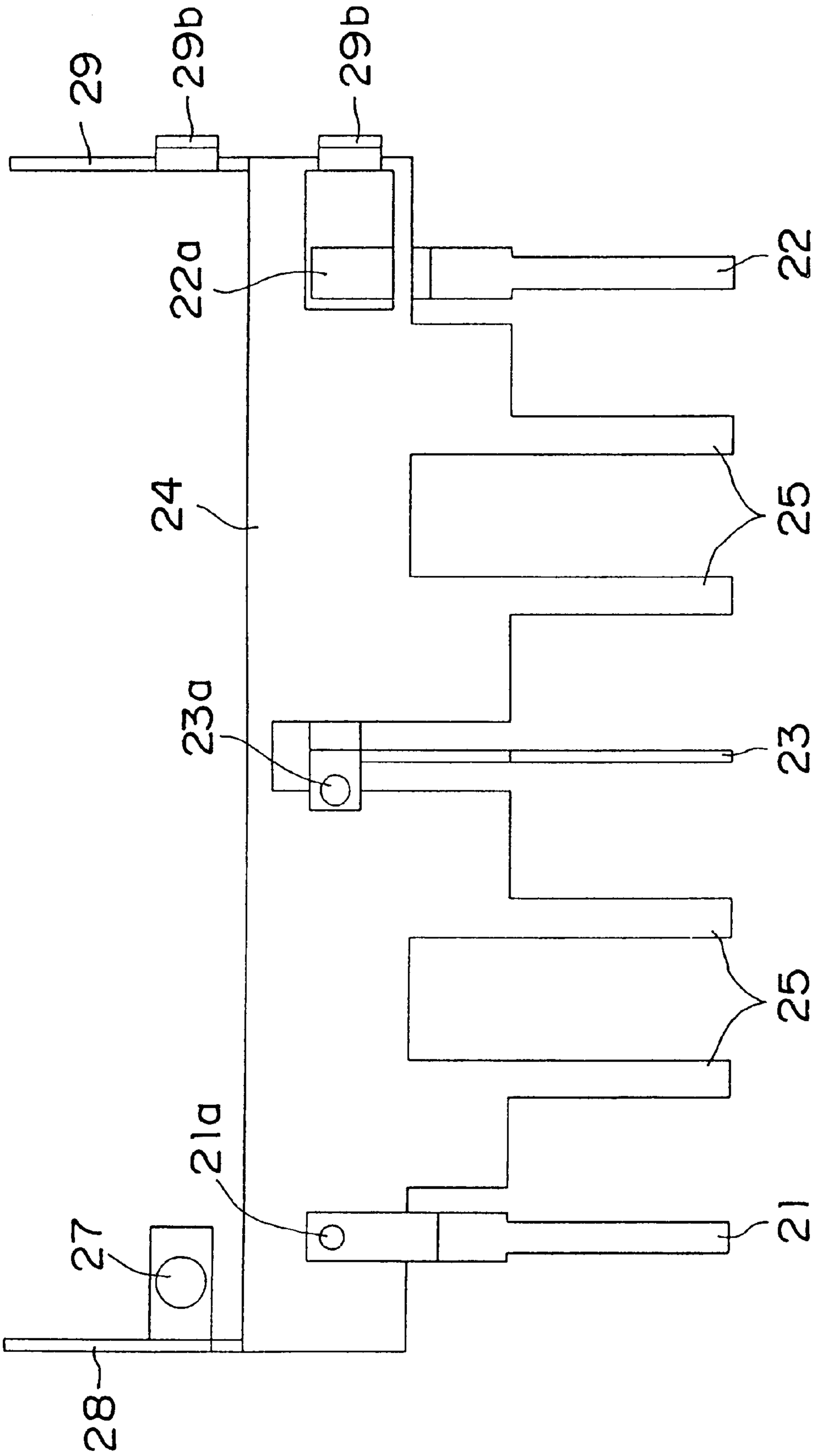
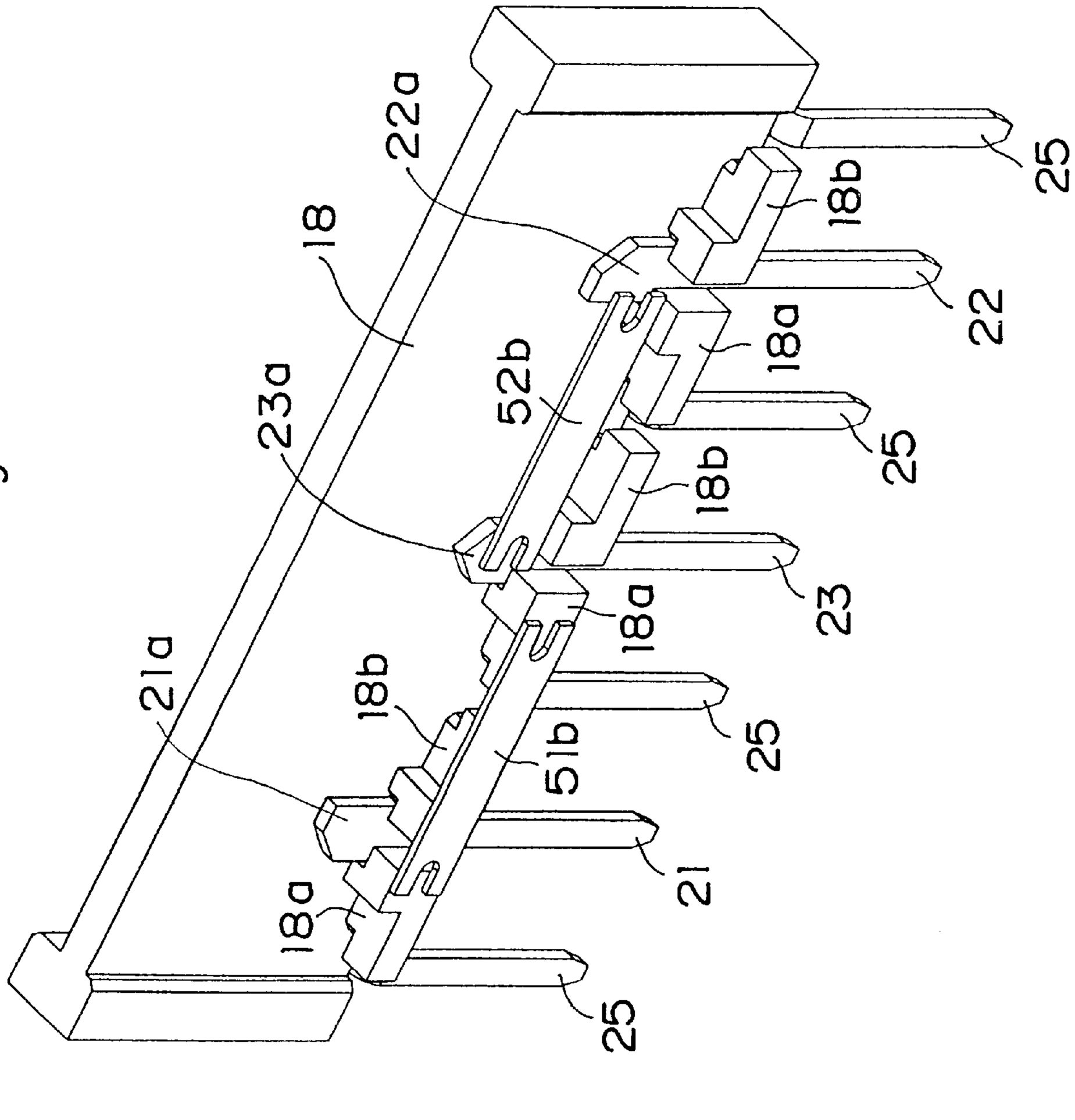


Fig. 13

Fig. 14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23a
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51b
18a
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22
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25
23
25
21
25

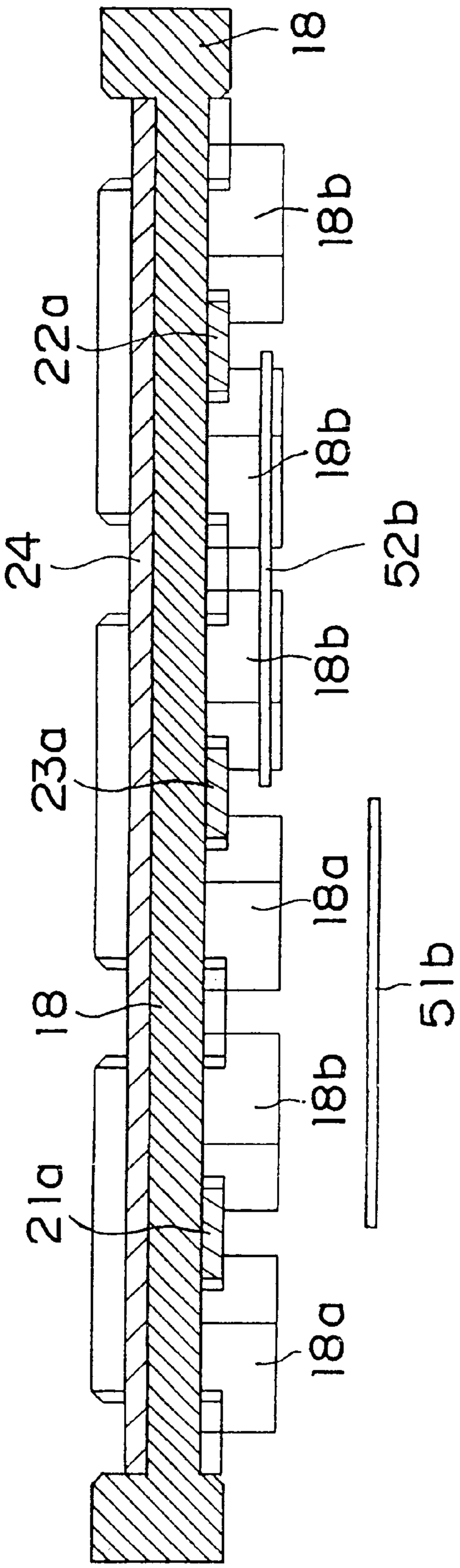
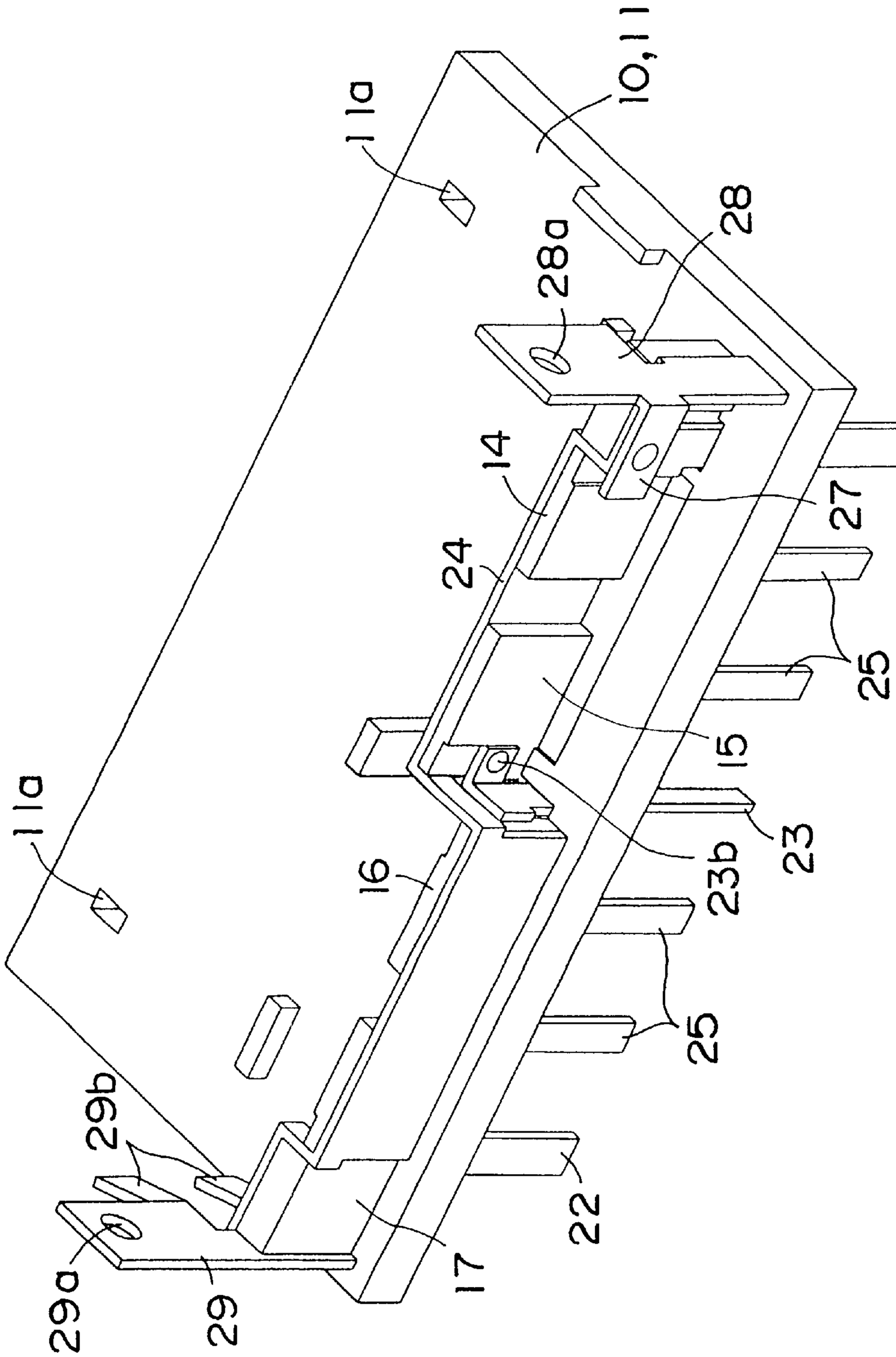
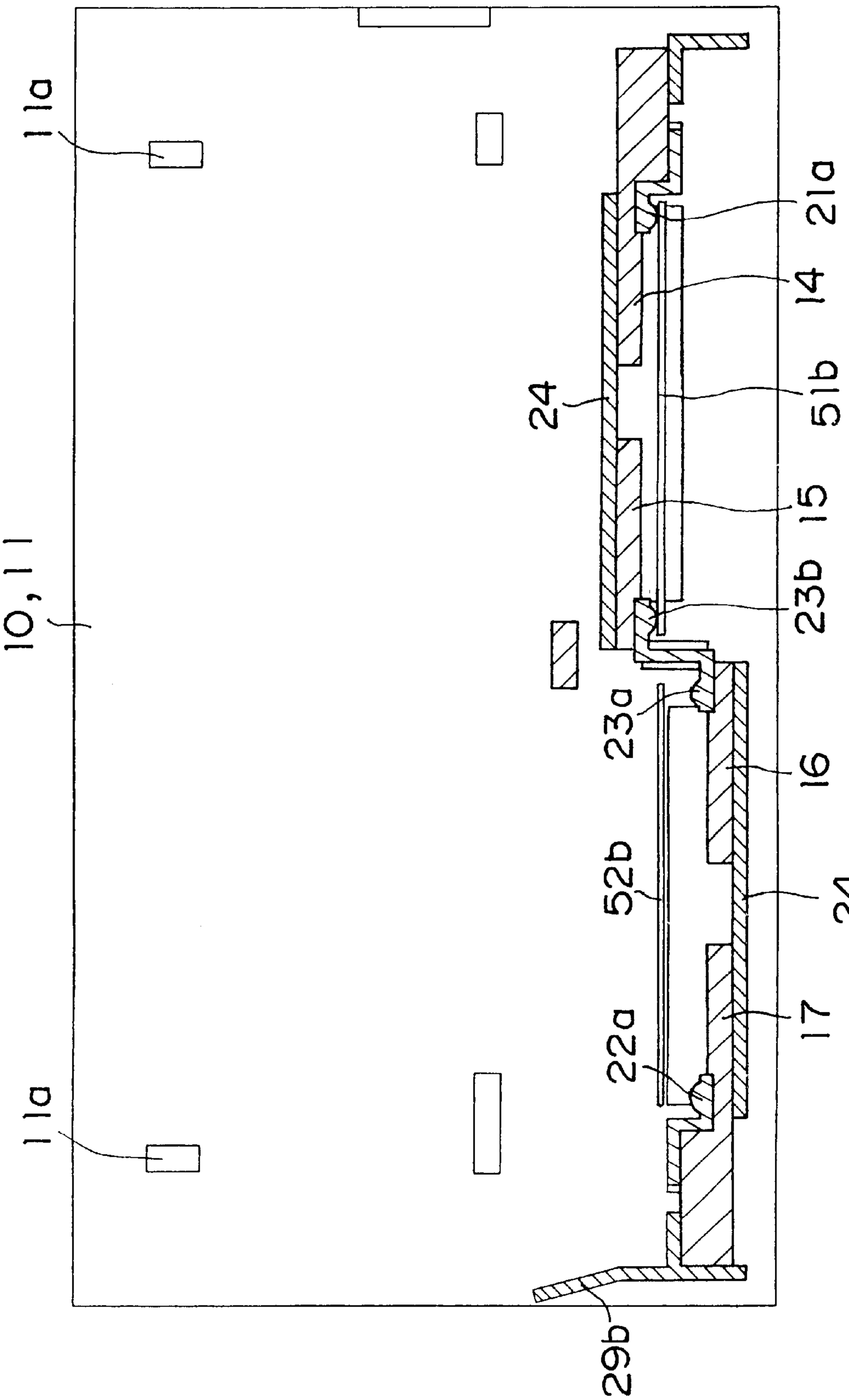


Fig.15

Fig.16





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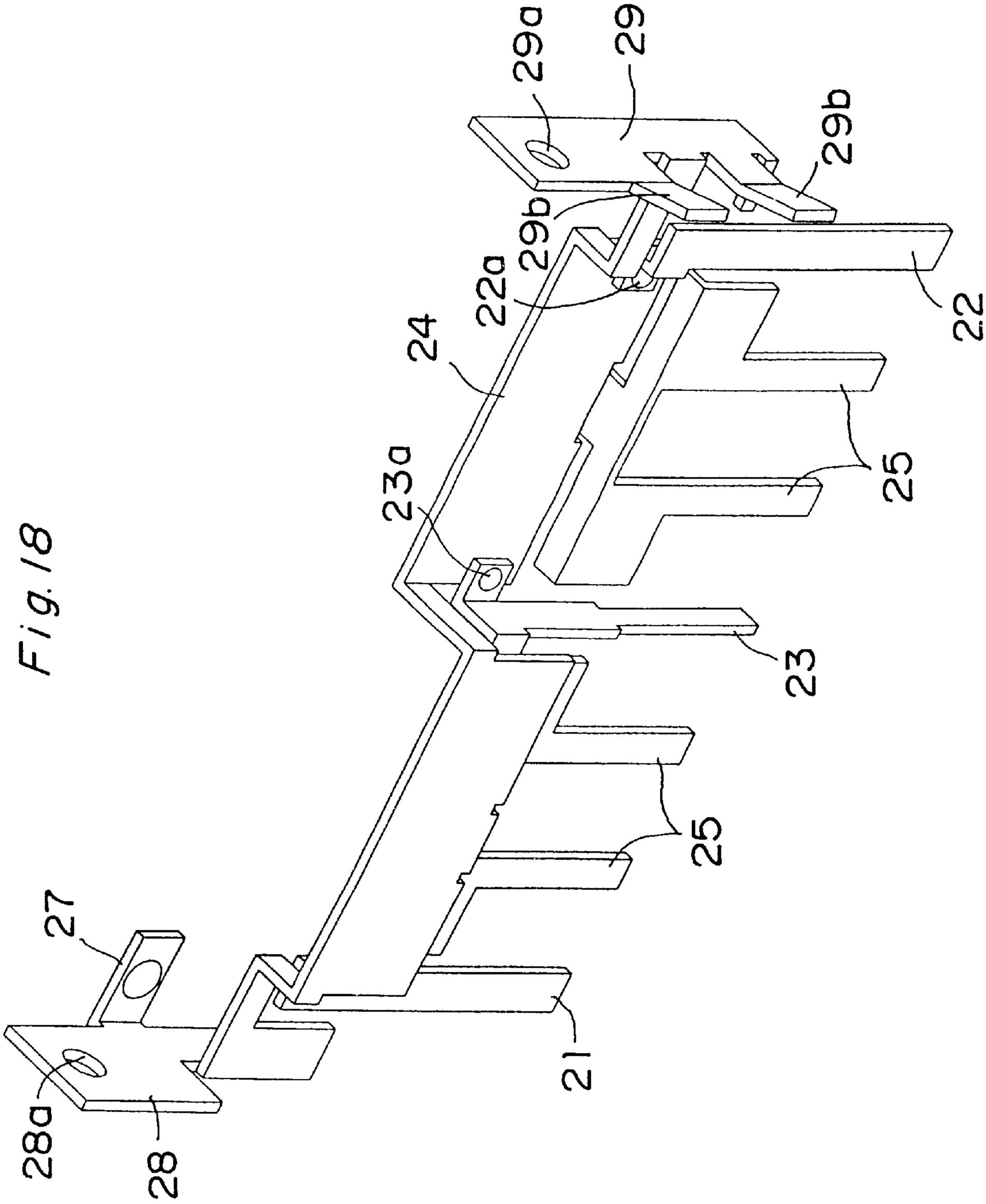

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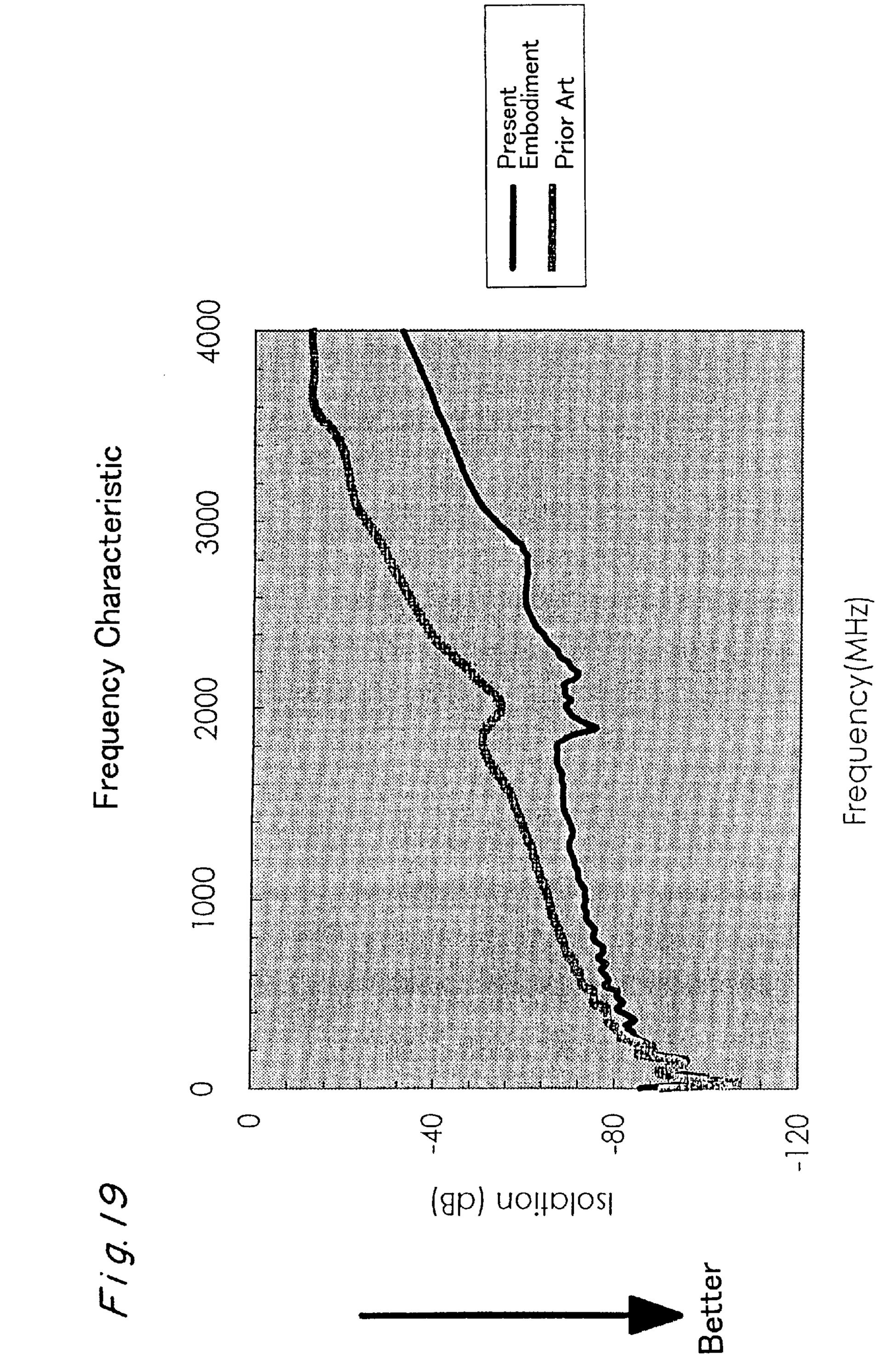
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Prior Art
Frequency Characteristic
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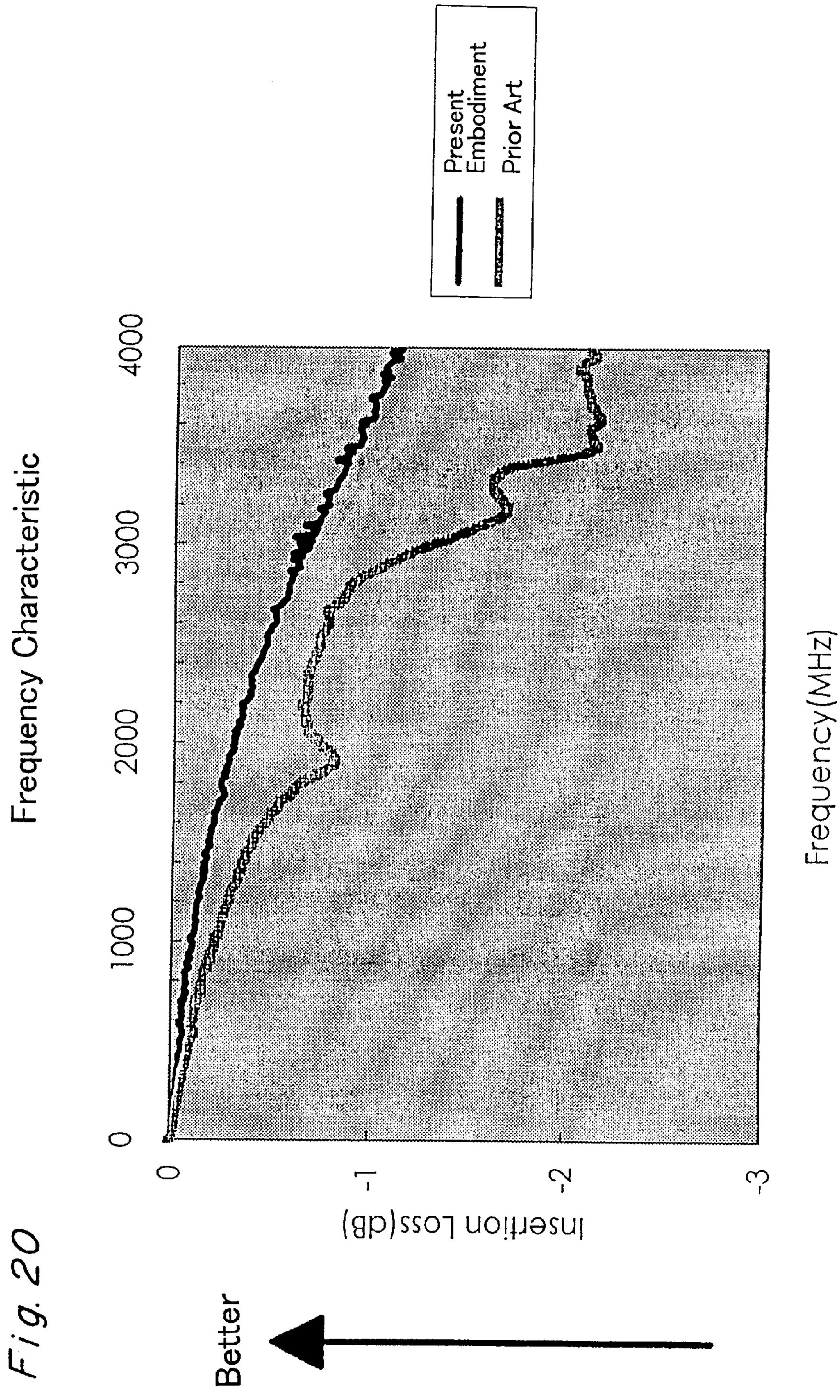
1000
2000
3000
4000
Frequency(MHz)
0
-40
-80
-120
Isolation (dB)
Better

Fig. 19


Present Embodiment
Prior Art
Frequency Characteristic
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1000
2000
3000
4000
Frequency(MHz)
0
-1
-2
-3
Insertion Loss(dB)
Better

Fig. 20

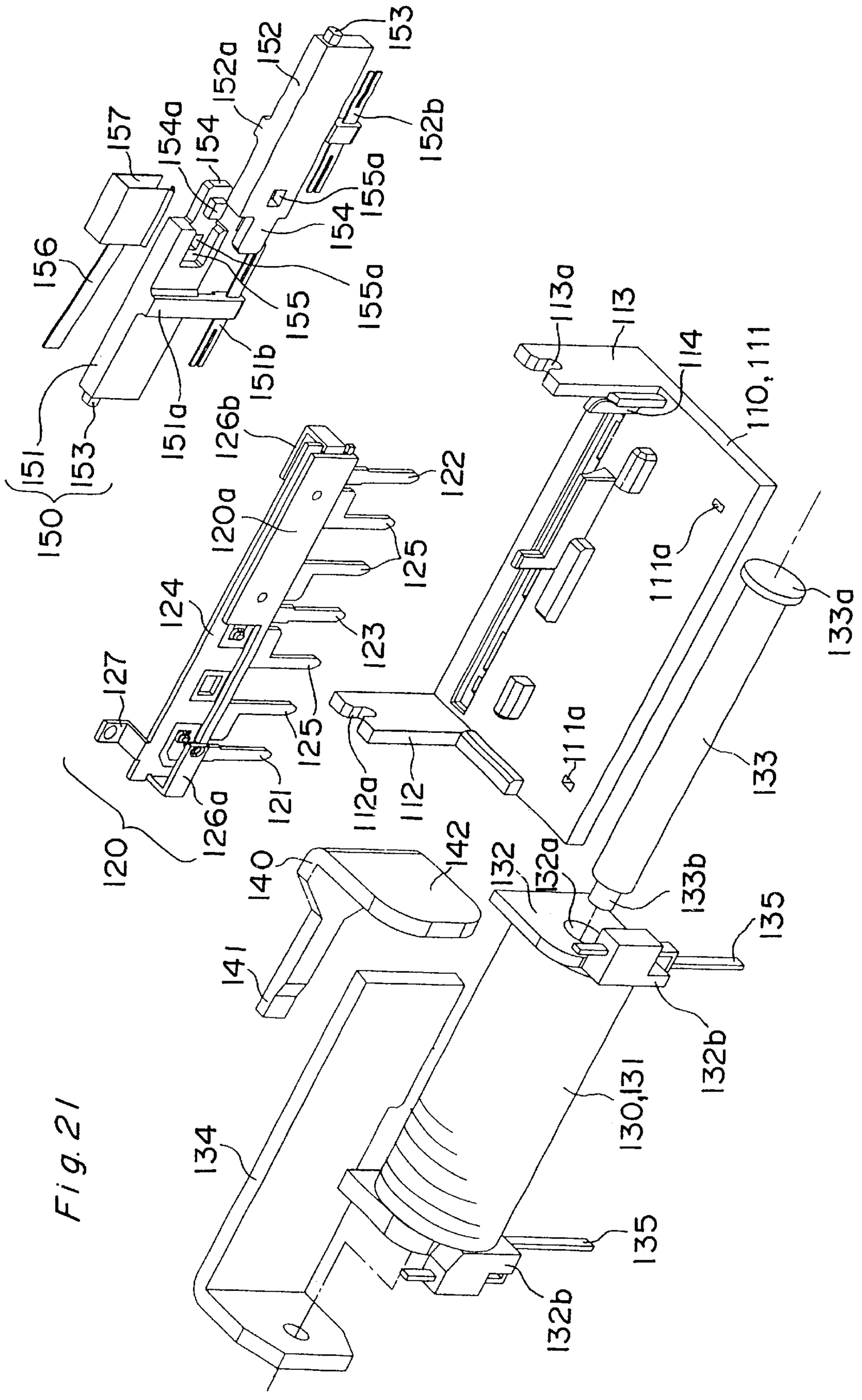
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Fig. 21

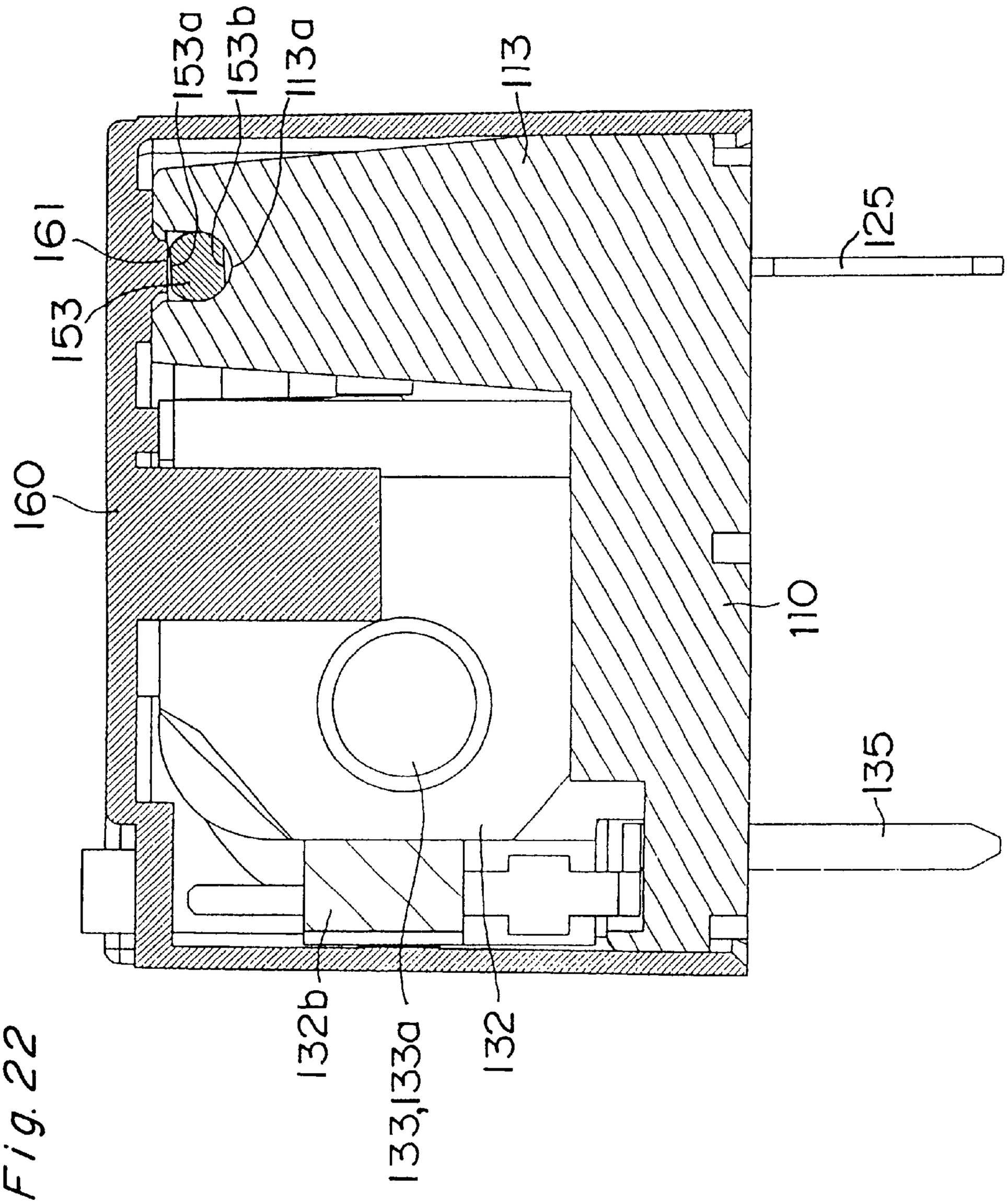
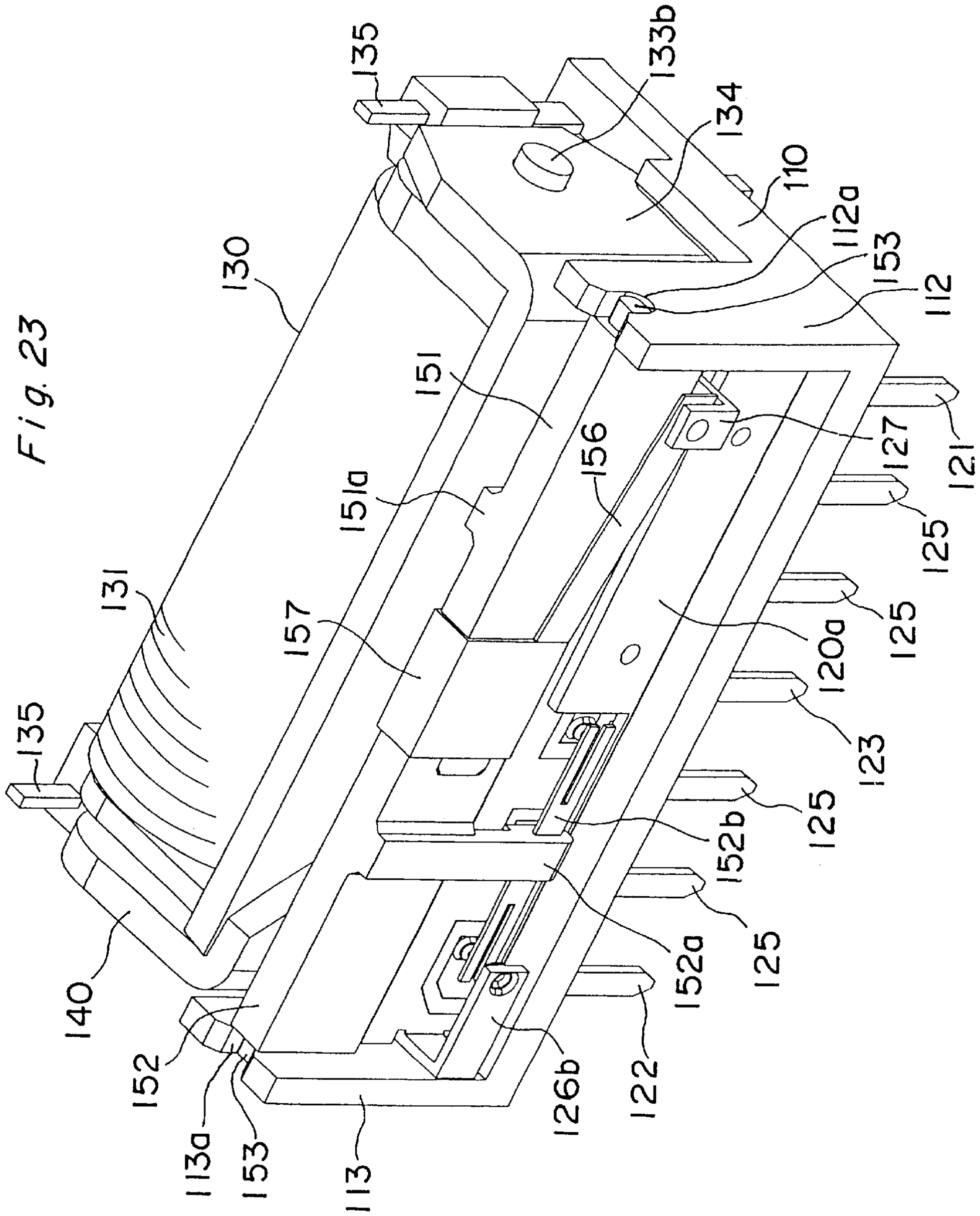


Fig. 22

Fig. 23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152a
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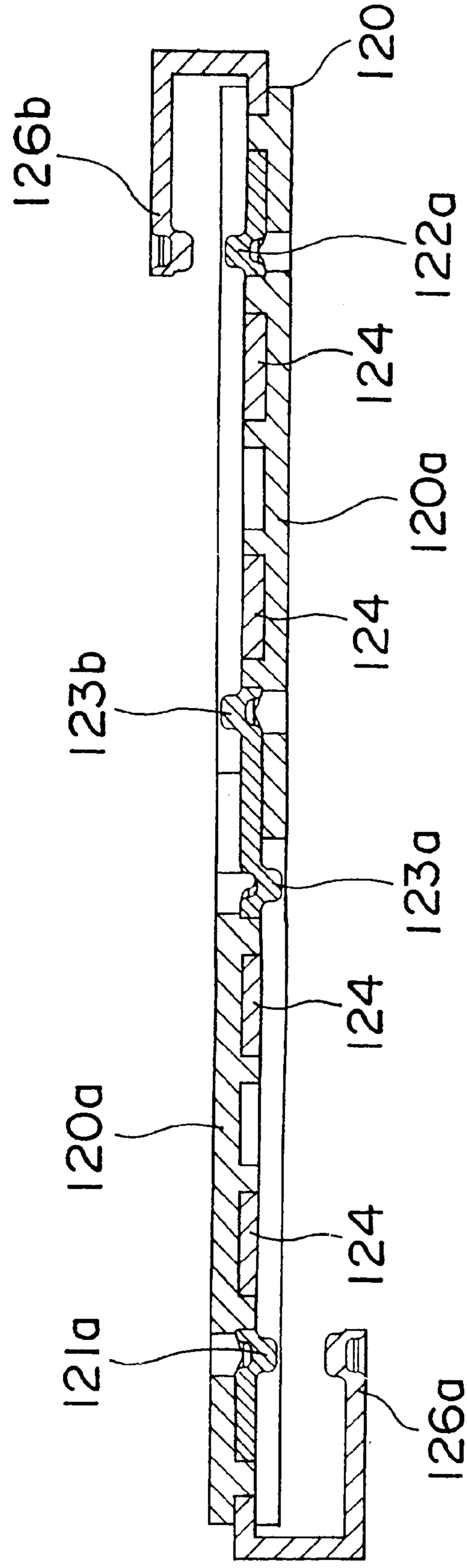
140
152
126b
122
113a
153
113



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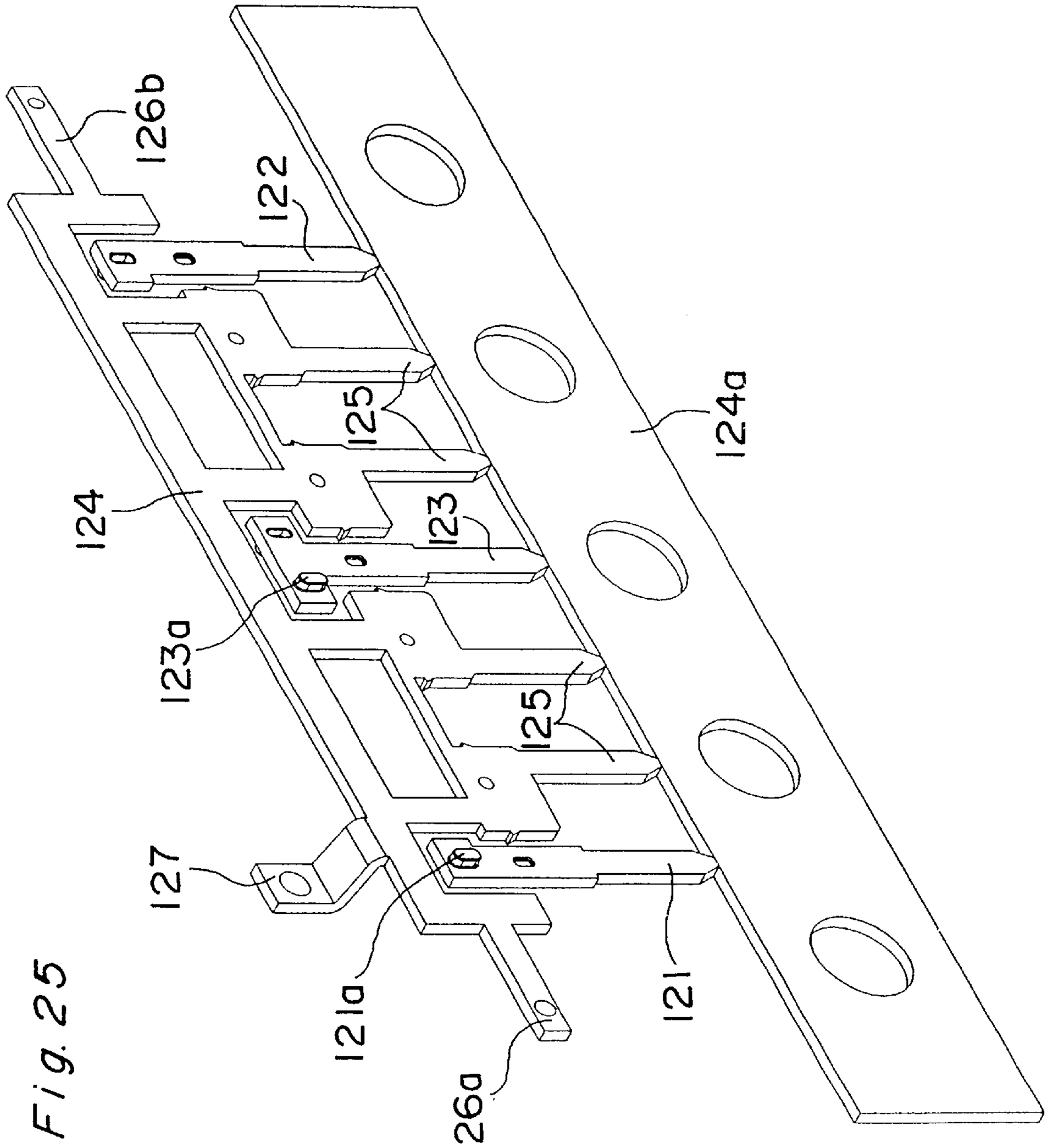

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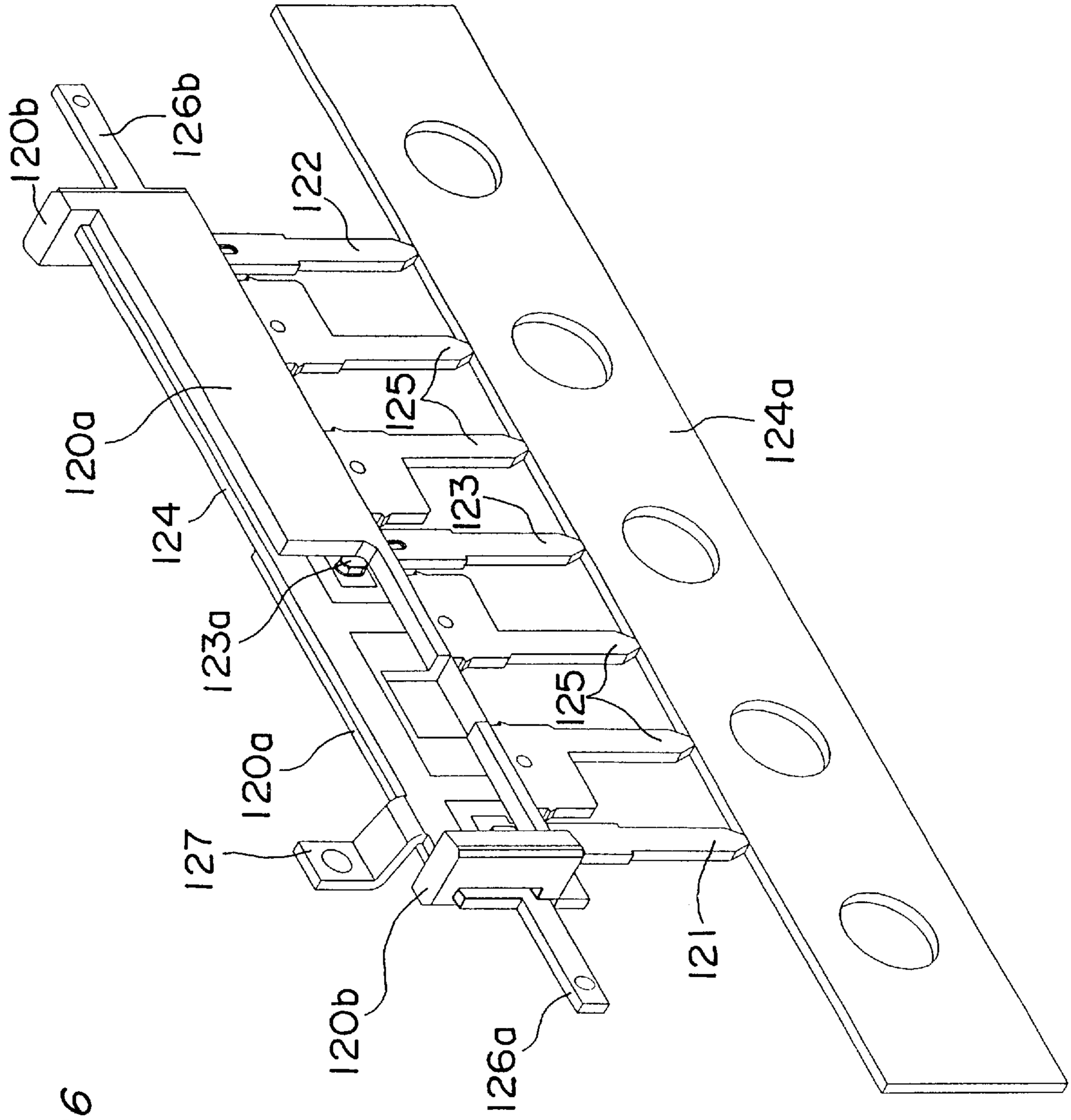
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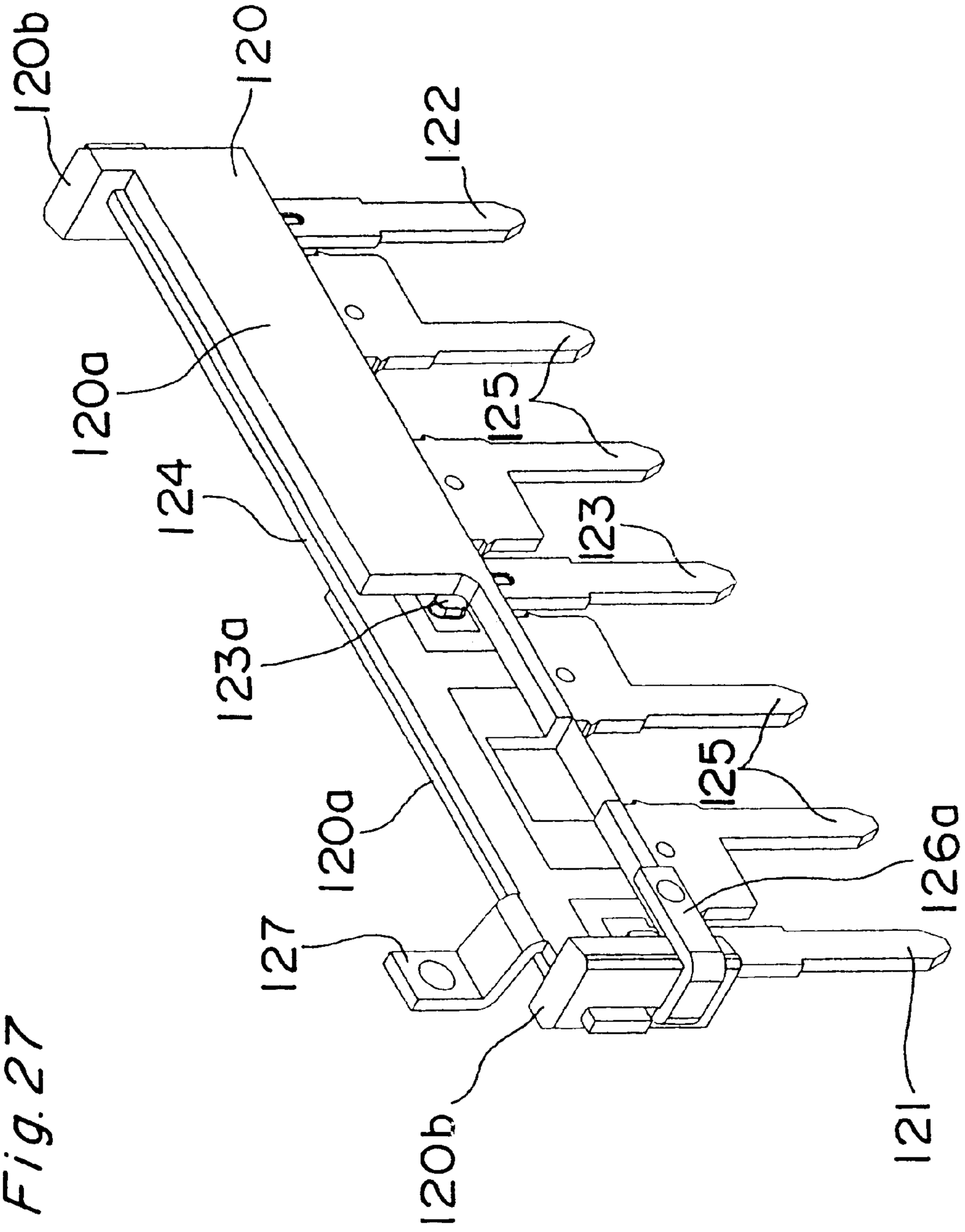
Fig. 26



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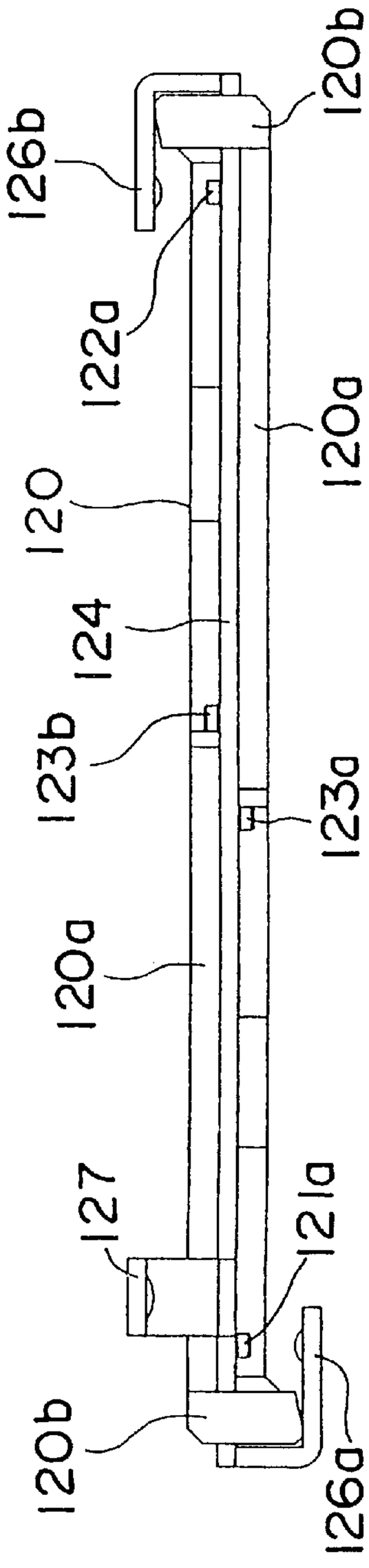
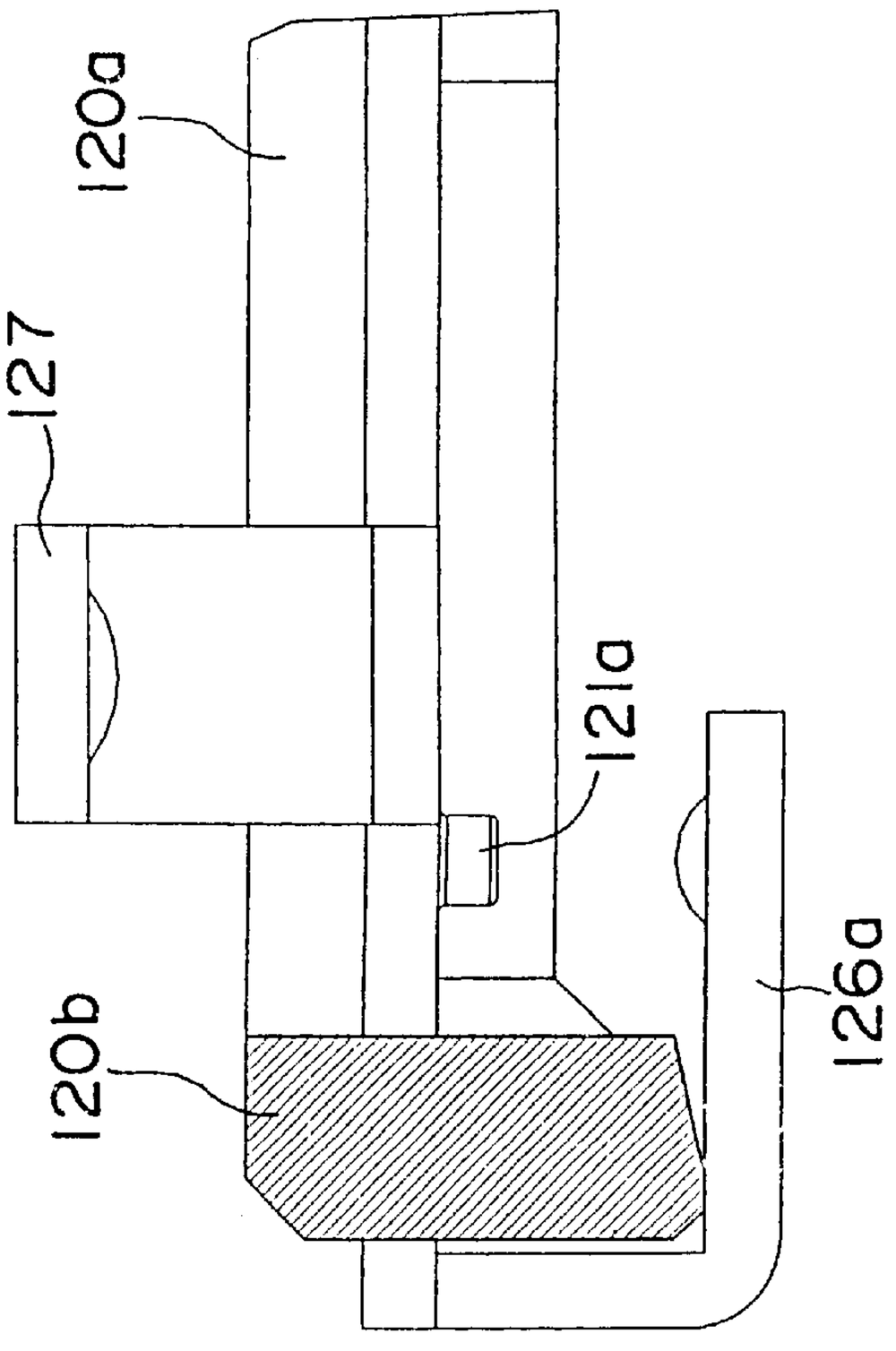


Fig. 28A



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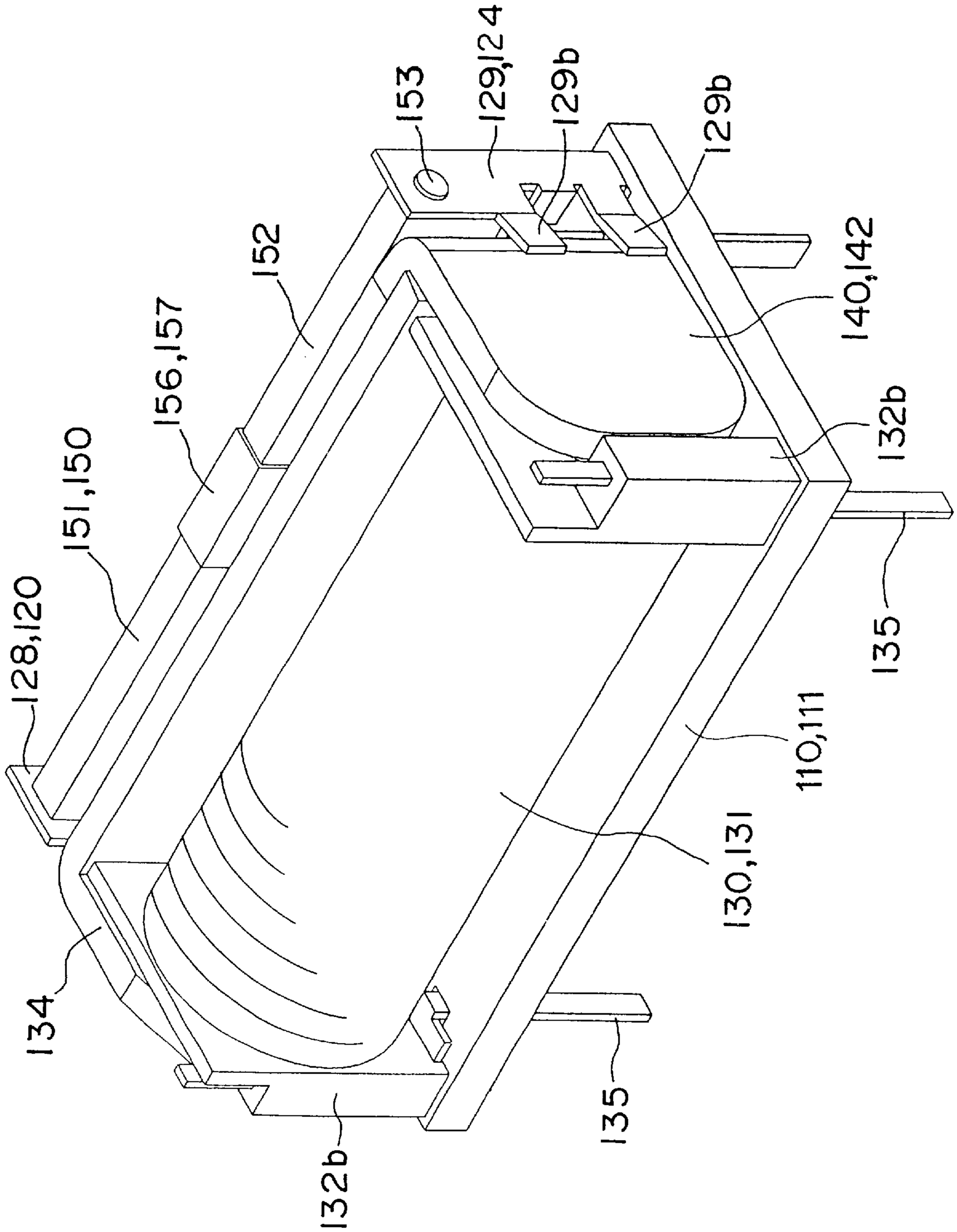
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132b

Fig. 29

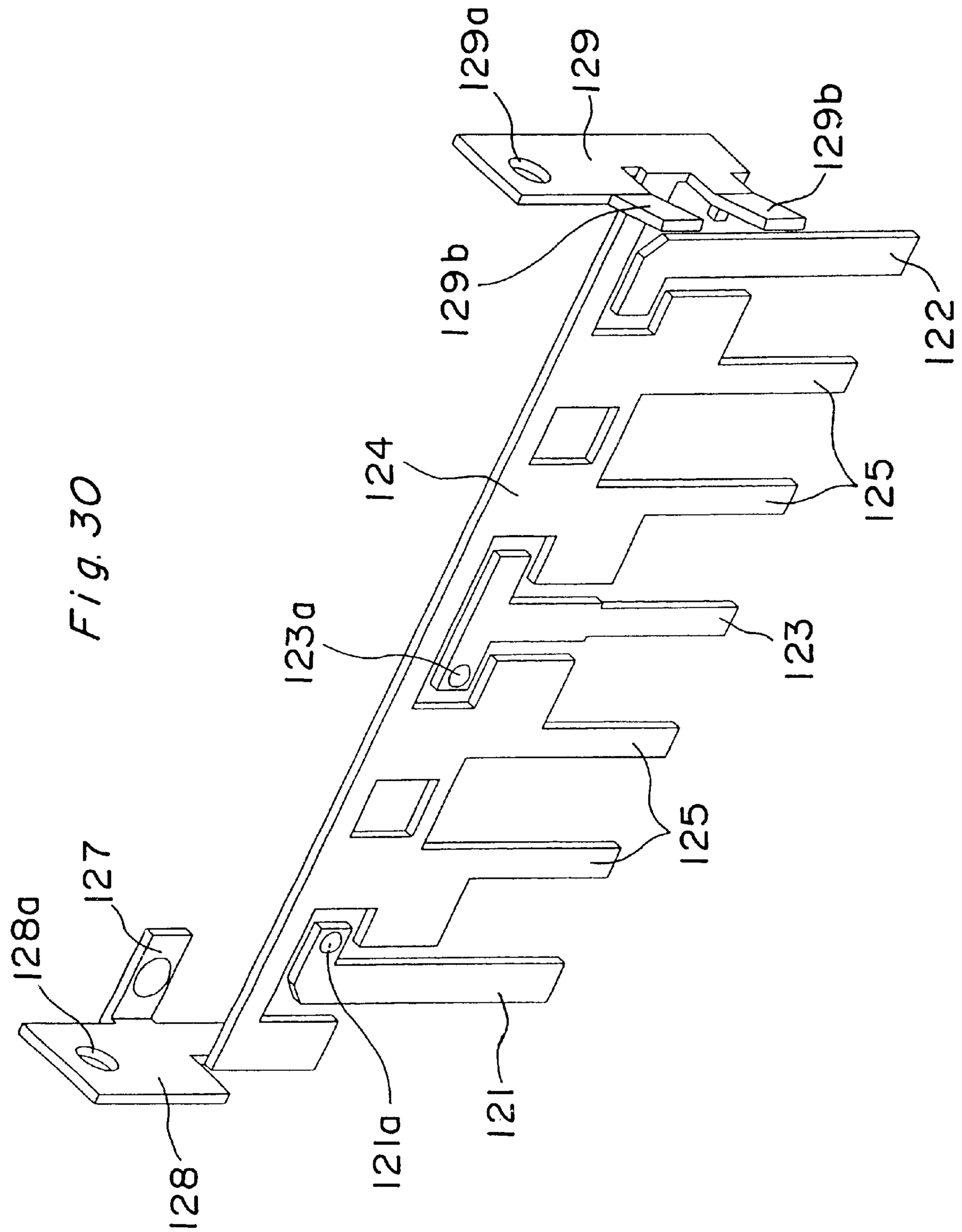


Fig. 30

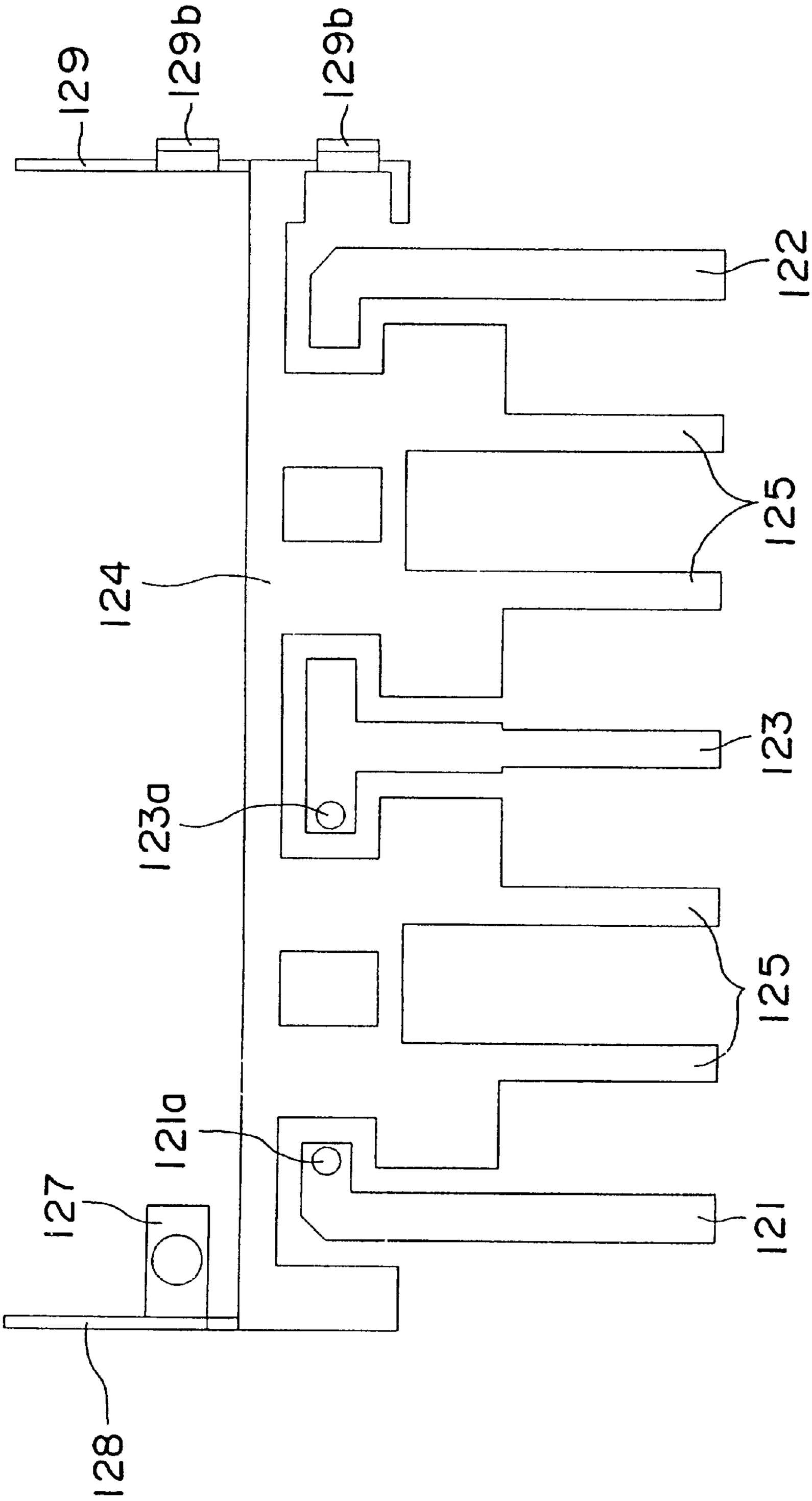
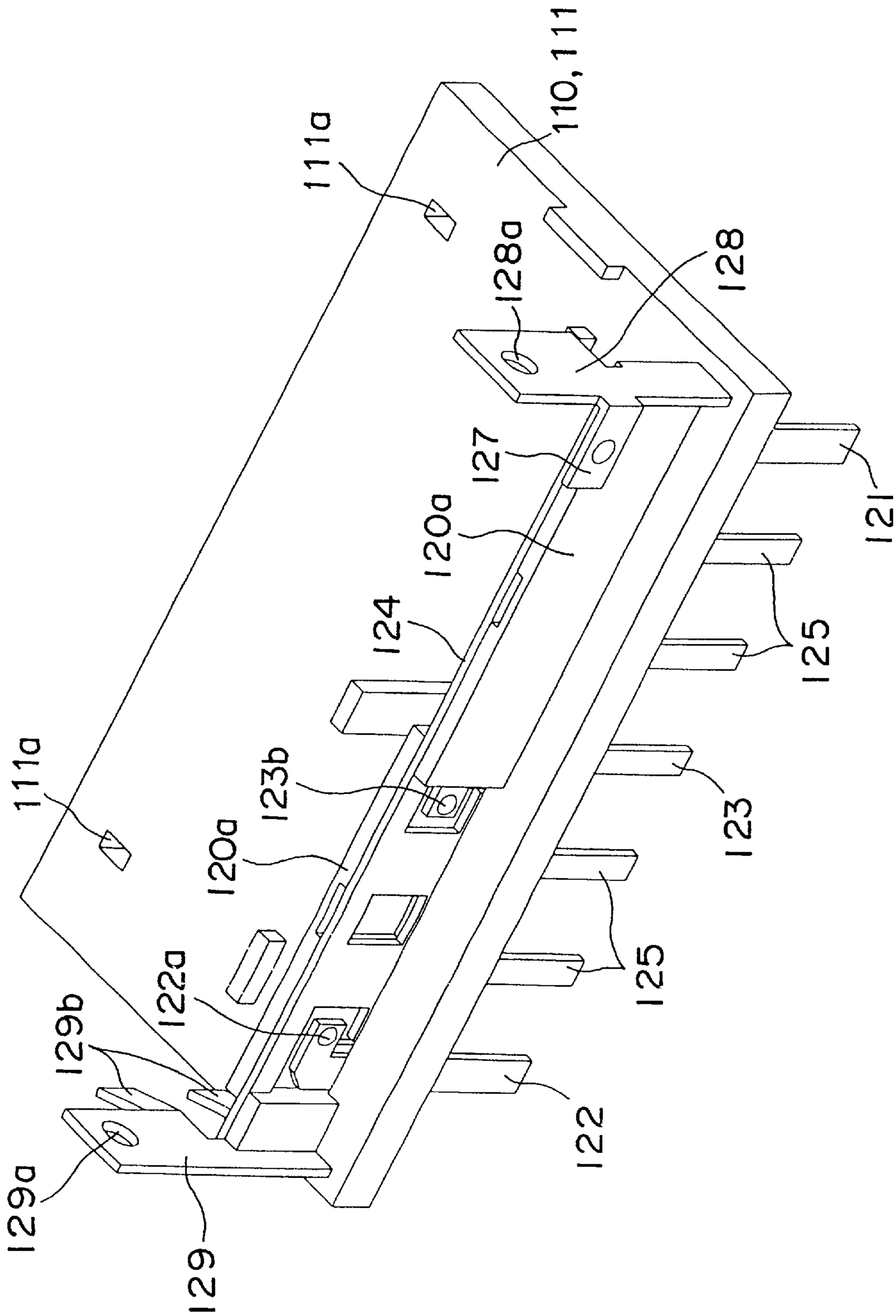


Fig. 31

Fig. 32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129b
129a
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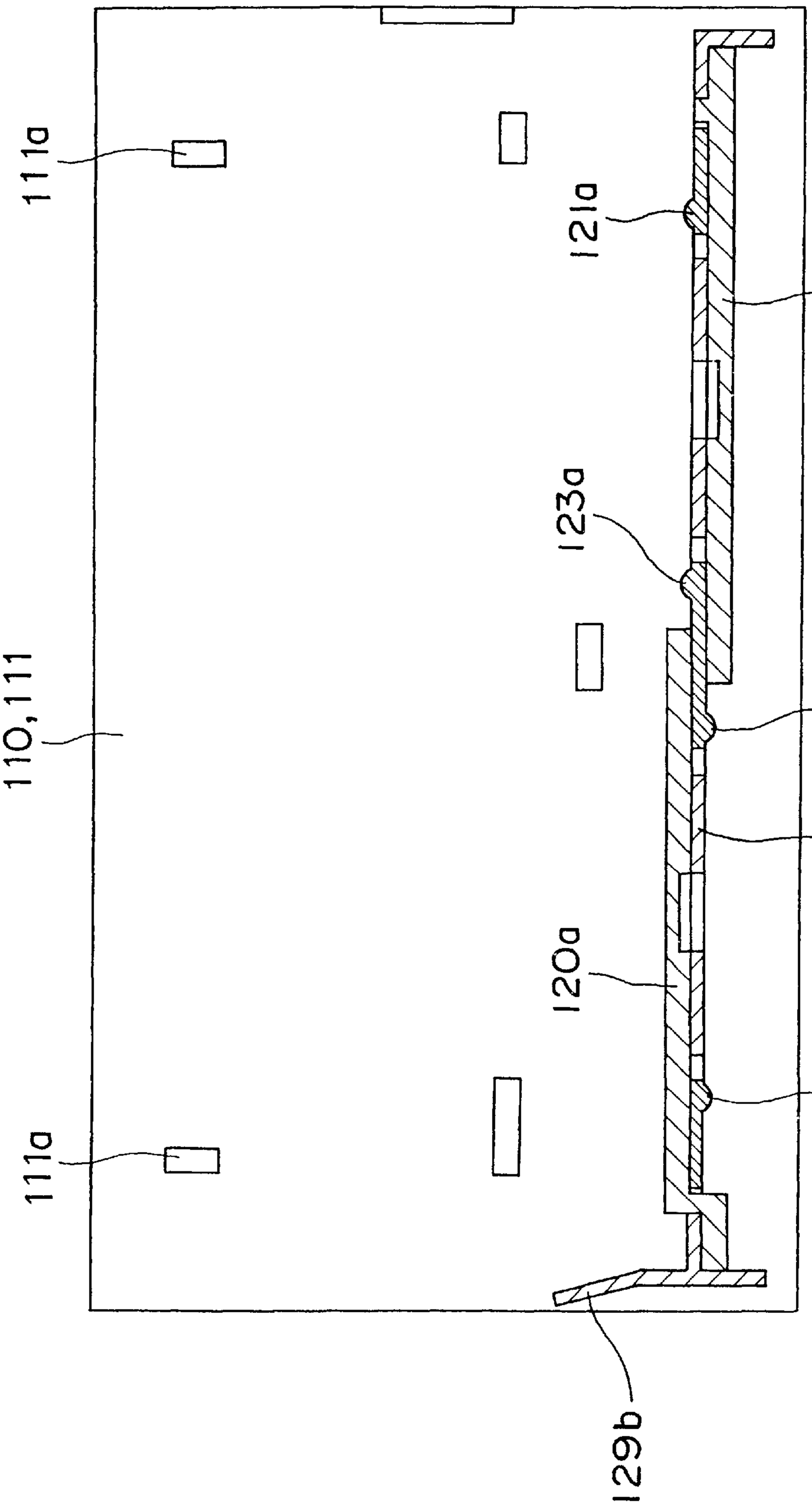

Fig.33

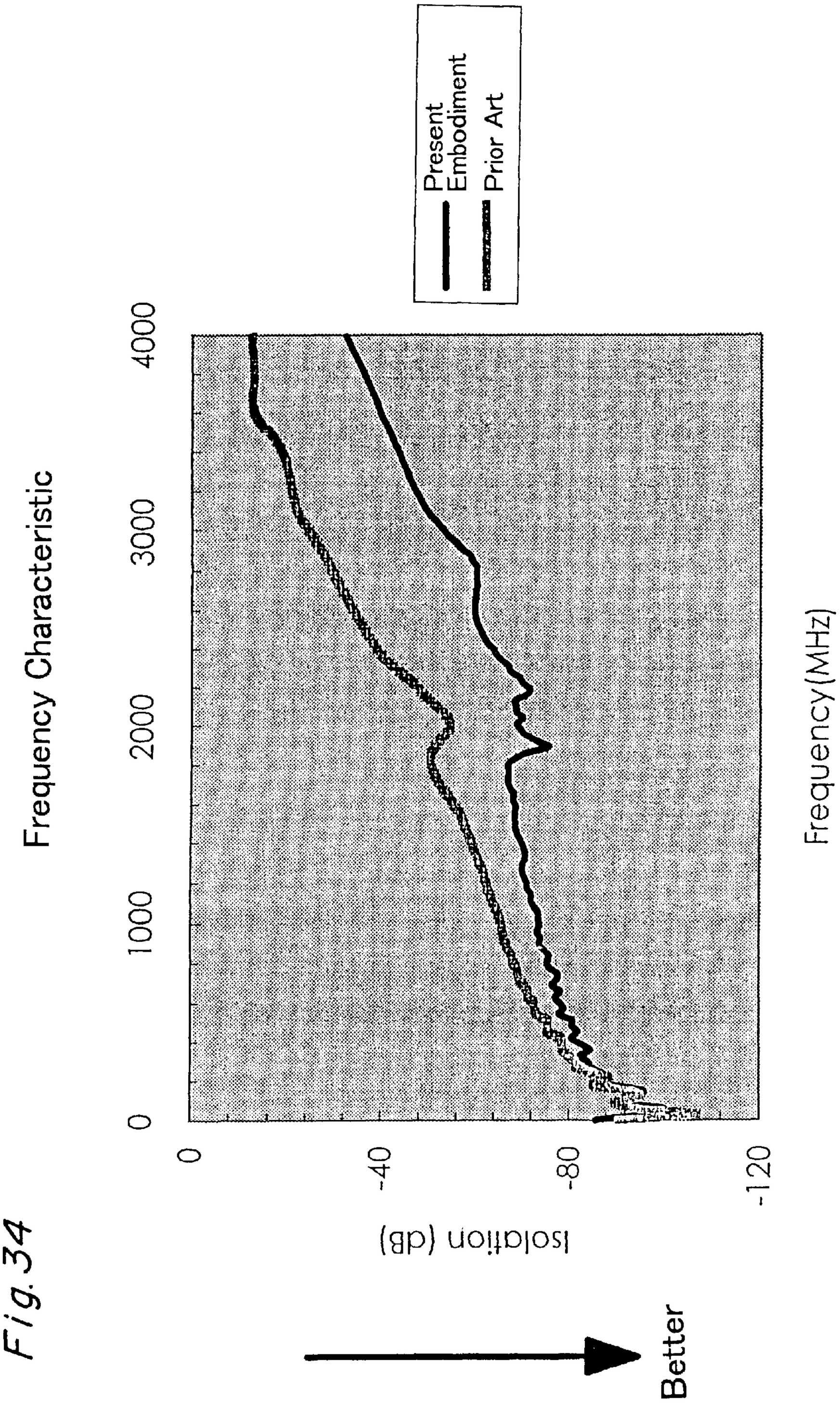
Present Embodiment
Prior Art
Frequency Characteristic
0
1000
2000
3000
4000
Frequency(MHz)
0
-40
-80
-120
Isolation (dB)
Better

Fig. 34

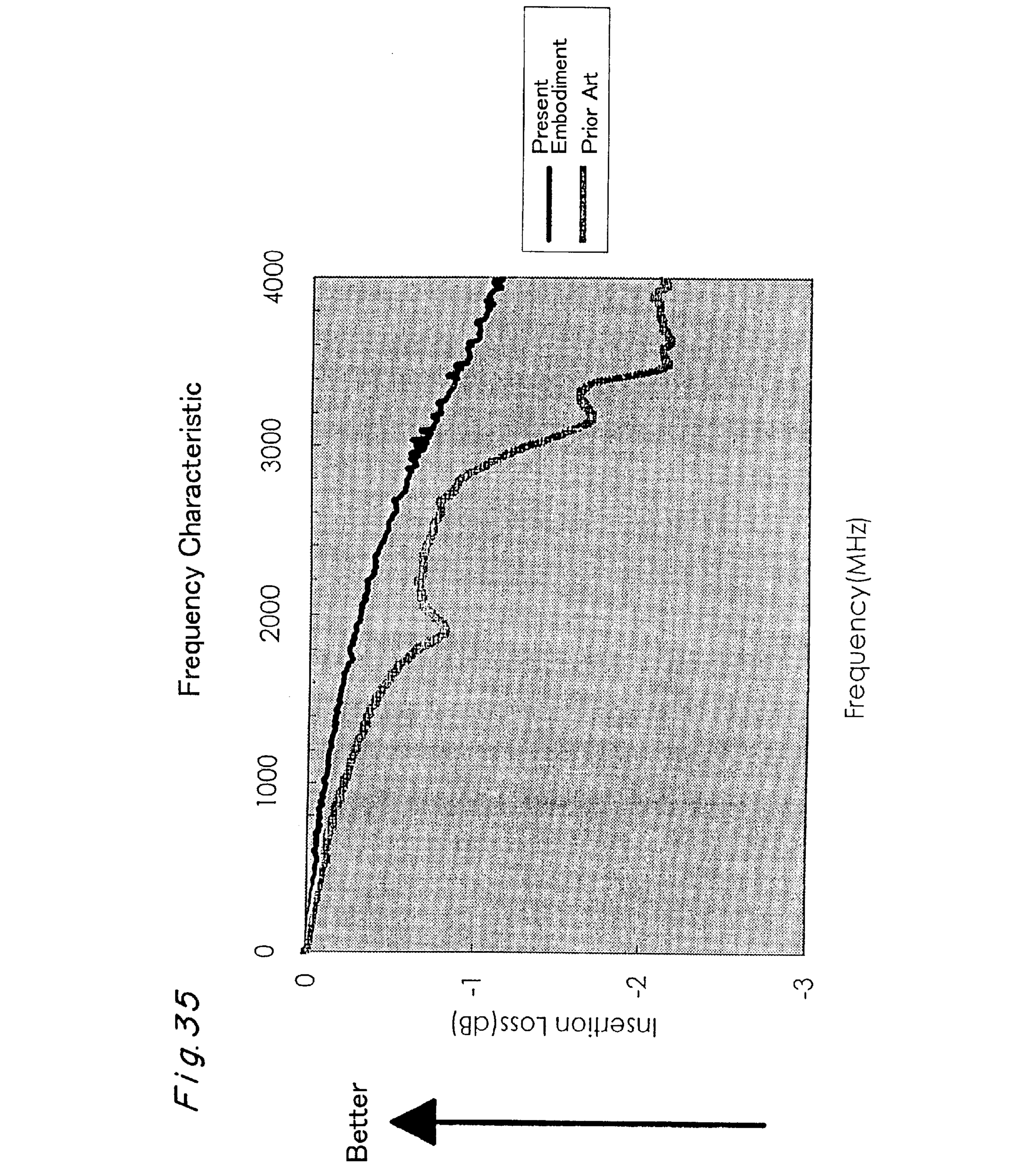
Present Embodiment
Prior Art
Frequency Characteristic
0
1000
2000
3000
4000
Frequency(MHz)
0
-1
-2
-3
Insertion Loss(dB)
Better

Fig. 35

SWITCH FOR HIGH FREQUENCY

TECHNICAL FIELD

The present invention relates to high-frequency use switches, and in particular, to a high-frequency use switch intended principally for switching a high-frequency current circuit.

BACKGROUND ART

Conventionally, there has been a high-frequency use switch as disclosed, for example, in Japanese Utility Model Publication No. HEI 6-38354, for the purpose of improving the high-frequency characteristic of the high-frequency use switch.

This is a high-frequency use switch such that a box-shaped shield casing is mounted on a substrate that is insert-molded in line with a fixed contact member and a movable contact member is brought in and out of contact with an upper end portion of the fixed contact member that is projecting from a bottom surface of this shield casing, thereby opening and closing the high-frequency current circuit.

However, the aforementioned high-frequency use switch is hard to obtain the desired high-frequency characteristic and also necessitates the box-shaped shield casing having a complicated shape. These factors lead to the problems of low productivity and difficulties in dimensional reduction.

In view of the aforementioned problems, the present invention has the object of providing a compact high-frequency use switch of a high productivity.

DISCLOSURE OF THE INVENTION

In order to achieve the aforementioned object, a first inventive feature of the present application is a high-frequency use switch, wherein a dielectric is arranged between a fixed contact that faces a movable contact while being able to come in and out of contact with it and a shield member located in the vicinity of the fixed contact.

A second inventive feature of the present application is a high-frequency use switch, wherein a plurality of movable contactors that reciprocate in the direction of thickness thereof on the basis of excitation and nonexcitation of an electromagnet block are brought in and out of contact alternately with a common fixed contact and a normally-open fixed contact and with the common fixed contact and a normally-closed fixed contact so as to open and close a high-frequency current circuit, and wherein a dielectric is arranged between the fixed contact and a shield member positioned in the vicinity of the fixed contact.

According to the first or second inventive feature of the present application, the desired frequency characteristic can be secured without using a box-shaped shield casing having a complicated shape as in the prior art. For this reason, a compact high-frequency use switch can be obtained with high productivity.

A third inventive feature is a high-frequency use switch characterized in that the dielectric is an insulating wall integrally formed with a base.

According to the third feature, the dielectric is the insulating wall integrated with the base, and there is a reduction in the number of components and assembling processes. For this reason, a compact high-frequency use switch can be obtained with higher productivity.

A fourth feature is that the dielectric is constructed of a plurality of insulating walls arranged parallel to each other with a distance between opposite faces equal to the thickness of the shield member.

According to the fourth feature, the dielectric serves as a member for positioning the shield member, and therefore, the assembling performance is improved.

A fifth feature is that a lower end portion of a fixed contact terminal provided with the fixed contact and a lower end portion of a ground terminal extended from the shield member are arranged in line with each other.

According to the fifth feature, the terminal portion of the fixed contact terminal and the ground terminal of the shield member are arranged in line with each other. For this reason, the mounting work on a printed board or the like is facilitated to a convenience.

A sixth feature is that a ground tongue with which the movable contactor comes in contact when separated from the fixed contact extends on the shield member.

According to the sixth feature, the movable contactor comes into contact with the ground tongue of the shield member when separated from the fixed contact, and therefore, the high-frequency characteristic when the contact is opened is further improved.

A seventh feature is that an engagement pawl with which a restoration spring for urging the movable contactor is engaged extends on the shield member.

According to the seventh feature, the restoration spring for urging the movable contactor is engaged with the engagement pawl of the shield member, and therefore, the assembly of the switch is facilitated.

An eighth feature is that a pair of common fixed contacts whose contact surfaces to be brought in contact with the movable contactor are directed in opposite directions are provided in upper portions of the common fixed contact terminal.

According to the eighth feature, the different movable contactors alternately come into contact with the pair of fixed contacts provided at the upper portions of the common fixed contact terminal. This arrangement allows the obtainment of a high-frequency use switch capable of opening and closing different high-frequency current circuits with interposition of the dielectric.

A ninth feature is that a pair of movable contactors that are arranged in parallel so as not to face each other are made to simultaneously reciprocate in the direction of plate thickness so as to come in contact alternately with the fixed contact, thereby opening and closing different high-frequency current circuits.

According to the ninth feature, the pair of movable contactors that are arranged in parallel so as not to face each other come in and out of contact alternately with the different fixed contacts. This arrangement allows the obtainment of a high-frequency use switch of which the adjacent movable contactors are magnetically influenced less, assuring a superior high-frequency characteristic.

A tenth feature is that a pair of movable contactors that are arranged in line with one another in an insulated state are made to simultaneously reciprocate in the direction of plate thickness so as to come in contact alternately with the fixed contact, thereby opening and closing different high-frequency current circuits.

According to the tenth feature, the pair of movable contactors arranged in line with each other in the insulated state alternately come in and out of contact with the fixed contact, thereby opening and closing the different high-frequency current circuits. This arrangement allows the

obtainment of a high-frequency use switch that facilitates the manufacturing of a movable block having the movable contactor, assuring higher productivity.

An eleventh feature is a high-frequency use switch, wherein a dielectric is arranged between a fixed contact that faces a movable contact while being able to come in and out of contact with it and a shield member positioned roughly in a plane identical to that of the fixed contact.

A twelfth feature is a plurality of movable contactors that reciprocate in the direction of thickness thereof on the basis of excitation and nonexcitation of an electromagnet block are brought in and out of contact alternately with a common fixed contact and a normally-open fixed contact and with the common fixed contact and a normally-closed fixed contact so as to open and close a high-frequency current circuit, and wherein a dielectric is arranged between the fixed contact and the shield member positioned in a plane roughly identical to that of the fixed contact.

According to the eleventh and twelfth features, the desired frequency characteristic can be secured without using a box-shaped shield casing having the complicated shape as in the prior art. For this reason, a compact high-frequency use switch can be obtained with high productivity.

Particularly by arranging the shield member and the fixed contact in the roughly identical planar form, the so-called coplanar guide structure can be constructed. For this reason, a high-frequency use switch having the desired frequency characteristic can be obtained.

Furthermore, the ground terminal of the shield member and the fixed contact are arranged in line with each other, so that the mounting work on the printed board or the like is facilitated.

A thirteenth feature is that the shield member and the fixed contact are integrated with each other by a dielectric.

According to the thirteenth feature, the shield member and the fixed contact are integrated with each other by the dielectric, and therefore, the number of components and the number of assembling processes in the assembling line are reduced to allow the productivity to be improved.

A fourteenth feature is that a ground tongue with which the movable contactor that is separated from the fixed contact comes in contact extends at least in one end portion of the shield member.

According to the fourteenth feature, the movable contactor comes into contact with the ground tongue of the shield member when separated from the fixed contact, and therefore, the high-frequency characteristic when the contact is opened is further improved.

A fifteenth feature is that a bending use shoulder portion is integrally formed with a base portion of the ground tongue.

According to the fifteenth feature, the bending use shoulder portion integrally formed with the base portion of the ground tongue can be used as a reference plane. For this reason, the ground tongue bending work becomes accurate, thereby allowing the assembling accuracy to be improved. Furthermore, the bending work can be performed rapidly, producing the effect of further improving the productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view showing a first embodiment of the high-frequency use switch of the present invention;

FIG. **2** is a cross sectional view of the high-frequency use switch shown in FIG. **1**;

FIG. **3** is a perspective view of the high-frequency use switch shown in FIG. **1**;

FIG. **4** is a perspective view showing a state in which the electromagnet block is dismounted from the high-frequency use switch of FIG. **3**;

FIG. **5** is a plan view of FIG. **4**;

FIG. **6** is a perspective view of the fixed contact mechanism shown in FIG. **1**;

FIG. **7** is a front view of FIG. **6**;

FIG. **8** is an exploded perspective view of the movable block shown in FIG. **1**;

FIG. **9**A is a perspective view of a movable block according to another embodiment;

FIG. **9**B is a side view thereof;

FIG. **10** is a perspective view showing a second embodiment;

FIG. **11** is a plan view of FIG. **10**;

FIG. **12** is a perspective view of the fixed contact mechanism shown in FIG. **10**;

FIG. **13** is a front view of FIG. **12**;

FIG. **14** is a perspective view of a third embodiment;

FIG. **15** is a sectional plan view of FIG. **14**;

FIG. **16** is a perspective view of a fourth embodiment;

FIG. **17** is a plan view of FIG. **16**;

FIG. **18** is a perspective view of the fixed contact mechanism shown in FIG. **16**;

FIG. **19** is a graph showing measurement results of high-frequency characteristic in the case where the contact is opened;

FIG. **20** is a graph showing measurement results of high-frequency characteristic in the case where the contact is closed;

FIG. **21** is an exploded perspective view showing a fifth embodiment of the high-frequency use switch of the present invention;

FIG. **22** is a longitudinal sectional view of the high-frequency use switch shown in FIG. **21**;

FIG. **23** is a perspective view of the high-frequency use switch shown in FIG. **21**;

FIG. **24** is a cross sectional view of the fixed contact block shown in FIG. **21**;

FIG. **25** is a perspective view showing a method for manufacturing a fixed contact block according to a sixth embodiment;

FIG. **26** is a perspective view showing a method for manufacturing a fixed contact block according to the sixth embodiment;

FIG. **27** is a perspective view of the fixed contact block of the sixth embodiment;

FIG. **28**A is a plan view of the fixed contact block shown in FIG. **27**;

FIG. **28**B is an enlarged view of part thereof;

FIG. **29** is a perspective view of a high-frequency use switch according to a seventh embodiment;

FIG. **30** is a perspective view of the fixed contact block shown in FIG. **29**;

FIG. **31** is a front view of FIG. **30**;

FIG. **32** is a perspective view of the base assembled with the fixed contact block shown in FIG. **30**;

FIG. **33** is a plan view of FIG. **32**;

FIG. **34** is a graph showing measurement results of high-frequency characteristic in the case where the contact is opened; and

FIG. **35** is a graph showing measurement results of high-frequency characteristic in the case where the contact is closed.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiments of the present invention will be described next with reference to the accompanying drawings of FIG. **1** through FIG. **35**.

As shown in FIG. **1** through FIG. **9**, a first embodiment is constructed roughly of a base **10**, a fixed contact mechanism **20**, an electromagnet block **30**, an armature **40**, a movable block **50** and a casing **60**.

The base **10** is provided with support walls **12** and **13** that project at the corner portions on the opposite sides of a flat base body **11** made of a dielectric (synthetic resin) and with discontinuous insulating walls **14**, **15**, **16** and **17** arranged between them. Upper end portions of the support walls **12** and **13** are formed with bearing grooves **12***a* and **13***a*, respectively, for pivotally supporting the movable block **50** described later. A base portion of the support wall **13** is formed with a positioning use projecting portion **18** provided with an arc surface that serves as a pivot support of the armature **40** described later.

The fixed contact mechanism **20** is constructed of identically-shaped fixed contact terminals **21** and **22** having fixed contacts **21***a* and **22***a*, respectively, a common fixed contact terminal **23** having common fixed contacts **23***a* and **23***b* and a shield plate **24**.

In particular, the fixed contact **21***a* and the common fixed contact **23***a* constitute a normally-open fixed contact mechanism, while the fixed contact **22***a* and the common fixed contact **23***b* constitute a normally-closed fixed contact mechanism.

As shown in FIG. **6** and FIG. **7**, the shield plate **24** is formed by punching a plate-shaped conductive material into a specified shape and press-processing the same. Then, the shield plate **24** has a plurality of ground terminals **25** projecting in line with one another on the lower side and ground tongues **26***a* and **26***b* formed by inwardly bending extended both end portions. Further, an engagement pawl **27** to be engaged with a restoration spring **56** for the movable block **50**, described later, is projecting from an upper edge portion of the shield plate **24**.

By press-fitting the lower end portions of the fixed contact terminals **21** and **22** and the common fixed contact terminal **23** as well as the ground terminals **25** of the shield plate **24** into terminal holes of the base **10**, then, as shown in FIG. **5**, the lower end portions of the fixed contact terminals **21** and **22**, the common fixed contact terminal **23** and the ground terminals **25** are arranged in line with one another. Further, the fixed contacts **21***a* and **22***a* and the common fixed contacts **23***a* and **23***b* abut against the side surfaces of the insulating walls **14** and **17** and the insulating walls **15** and **16**, respectively, thereby shielding one side of the fixed contacts **21***a* and **22***a* and the common fixed contacts **23***a* and **23***b*. With this arrangement, a shield structure utilizing the principle of the so-called strip line is obtained.

The electromagnet block **30** is formed by inserting an iron core **33** having a roughly. T-figured section shape into a center hole **32***a* of a spool **32** around which a coil **31** is wound. The one end portion projecting from the center hole **32***a* is made to serve as a magnetic pole piece **33***a*, while the projecting other end portion **33***b* is fixed in a caulking manner to one end portion of a yoke **34** bent roughly in an L-figured shape. Coil terminals **35** are press-fit into flange portions **32***b* of the spool **32**, and a lead wire of the coil **31** is wound around and soldered to this.

Then, by press-fitting the coil terminals **35** into terminal holes **11***a* of the base **10**, the electromagnet block **30** is positioned in the specified position.

The armature **40** is made of magnetic material and bent roughly in an L-figured shape, and its one end portion is formed into a narrowed portion **41**.

The armature **40** is assembled from above along the positioning use projecting portion **18** that is projecting from the upper surface of the base. Therefore, the armature **40** is pivotally supported on the inner surface of the positioning use projecting portion **18** used as a support, and its one end portion **42** can abut against the magnetic pole piece **33***a* of the iron core **33**.

As shown in FIG. **8**, the movable block **50** is made of a pair of movable bases **51** and **52** having an identical shape and a restoration spring **56**.

The movable bases **51** and **52** are constructed so that movable contactors **51***b* and **52***b* are insert-molded into the lower end portions of projecting bars **51***a* and **52***a* extended downward from the side surfaces. The movable bases **51** and **52** have shaft portions **53** that project laterally from their one side end portions as well as engagement use projecting portions **54** and **54** that project laterally from their other side end portions.

The shaft portions **53** have an escape formed with flat surfaces **53***a* and **53***b* that are vertically parallel to each other. Further, a burr that cannot be avoided in the resin forming process is generated on the flat surfaces **53***a* and **53***b*, thereby allowing a smooth pivoting operation to be obtained.

The base portion of the engagement use projecting portion **54** is formed with a recess portion **55** to be engaged therewith. Further, the projecting portion **54** is formed with a projection **54***a* to be press-fit into the through hole **55***a* formed in a recess portion **55** for the engagement.

Then, the projecting portion **54** of the movable base **51** is positioned while being fit in the recess portion **55** of the movable base **52**. Then, the projection **54***a* and the through hole **55***a* of the movable base **51** are press-fit on the through hole **55***a* and the projection **54***a* of the movable base **52**, temporarily fixed and thereafter connected and integrated with each other by adhesive, high-frequency welding or other means.

Further, by mounting a gripping portion **57** of the restoration spring **56** on the upper edge portions of the movable bases **51** and **52** that have been connected and integrated with each other, the movable block **50** is completed.

According to the present embodiment, the movable bases **51** and **52** having the identical shape are used, and accordingly, there is the advantage that the resin molding is simplified and the manufacturing of the metal mold can be facilitated.

Then, the shaft portions **53** and **53** of the movable block **50** are fit into the bearing grooves **12***a* and **13***a* of the base **10**, thereby pivotally supporting the movable block **50** in the direction of its thickness. With this arrangement, the movable contactor **51***b* faces the fixed contacts **21***a* and **23***a* or the ground tongue **26***a* while being able to come into and out of contact alternately with them. On the other hand, the movable contactor **52***b* faces the fixed contacts **22***a* and **23***b* or the ground tongue **26***b* while being able to come into and out of contact alternately with them. Then, the tip portion of the restoration spring **56** is engaged with the engagement

pawl **27** of the shield plate **24**, thereby urging the movable block **50** toward the electromagnet block **30** side.

Although: the aforementioned embodiment has been described on the basis of the case where the movable block **50** is formed by combining the two movable bases **51** and **52** with each other, the present invention is not always limited to this. As shown in FIGS. **9**A and **9**B, the movable block **50** may be integrally formed originally. According to this embodiment, the movable block **50** having a high dimensional accuracy free of any assembling error as observed in the aforementioned embodiment can be obtained. This arrangement has the advantage that a high-frequency use switch of uniform operation characteristics can be obtained.

The casing **60** has a box-like shape that can fit on the base **10**, and portions that belong to its ceiling surface and are located just above the shaft portions **53** of the movable block **50** are provided with a positioning use projecting portion **61** for preventing a lift (see FIG. **2**).

When the casing **60** is fit on the base **10** integrated with the internal components, the positioning use projecting portion **61** faces the flat surface **53***a* of the shaft portion **53** with a minute gap retained between them. Then, by sealing the contact surface of the base **10** and the casing **60** with a sealant, the assembling work is completed.

The operation of the high-frequency use switch having the aforementioned construction will be described next.

When no voltage is applied to the coil **31** of the electromagnet block **30**, the movable block **50** is urged toward the electromagnet block **30** side by a spring force of the restoration spring **56**. Then, the movable contactor **51***b* is put in contact with the ground tongue **26***a,* while the movable contactor **52***b* is put in contact with the fixed contacts **23***b* and **22***a*.

When a voltage is applied to the coil **31** for the excitation, the one end portion **42** of the armature **40** is attracted to the magnetic pole piece **33***a* of the iron core **33**. By this operation, the armature **40** pivots to make its narrowed portion **41** press the movable block **50** outward against the spring force of the restoration spring **56**. Consequently, the movable block **50** pivots around the shaft portions **53**, and the movable contactor **51***b* separates from the ground tongue **26***a* and comes into contact with the fixed contacts **21***a* and **23***a*. On the other hand, the movable contactor **52***b* separates from the fixed contacts **23***b* and **22***a* and comes into contact with the ground tongue **26***b*. Thereafter, the one end portion **42** of the armature **40** is attracted to the magnetic pole piece **33***a* of the iron core **33**.

Subsequently, if the application of the voltage to the coil **31** is stopped, then the movable block **50** pivots in the direction opposite to the pivotal direction by the spring force of the restoration spring **56**. By this operation, the movable contactor **51***b* comes into contact with the ground tongue **26***a*, and the movable contactor **52***b* comes into contact with the fixed contacts **23***b* and **22***a,* achieving restoration into the original state.

In contrast to the aforementioned first embodiment in which the movable block **50** is pivotally supported by the support walls **12** and **13** that are integrally formed with the base **10**, a second embodiment is as shown in FIG. **10** through FIG. **13**, in which support flaps **28** and **29** extend from both end portions of a shield plate **24** that is arranged upright while being press-fit into the base **10** and the shaft portions **53** and **53** of the aforementioned movable block **50** are pivotally supported while being inserted in bearing holes **28***a* and **29***a* provided for the support flaps **28** and **29**.

As shown in FIG. **11**, similar to the aforementioned first embodiment, the back surfaces of the fixed contacts **21***a* and **22***a* and the common fixed contacts **23***a* and **23***b* abut against the insulating walls **14** and **17** and **15** and **16** projecting from the base **10**, constituting a strip line in the present embodiment.

It is to be noted that the shield plate **24** has an engagement pawl **27** which is laterally extended from its support flap **28** and with which the free end portion of the restoration spring **56** is engaged. Further, the shield plate **24** has positioning tongues **29***b* which are laterally extended from the other support flap **29** and are brought in pressure contact with the bent corner portion of the armature **40** so as to pivotally support the armature.

According to the present embodiment, the fixed contact terminals **21** and **22** and the common fixed contact terminal **23** can be press-fit from below the base **10**, while the shield plate **24** can be press-fit from above. This arrangement has the advantage that the degree of freedom in assembling expands. The other part is similar to that of the aforementioned first embodiment, and therefore, no description is provided therefor.

A third embodiment is as shown in FIG. **14** and FIG. **15**, in which a strip line is constituted via an insulating wall **18** separated from the base **10**.

That is, the fixed contact terminals **21** and **22** and the common fixed contact terminal **23** are press-fit between three pairs of press-fitting use projecting portions **18***a* and **18***b* projecting from lower edge portions of the surface of the insulating wall **18** of a synthetic resin mold, while a shield plate **24** is assembled with the back surface of the insulating wall **18**.

Then, a movable contactor **51***b* or **52***b* that reciprocates in the direction of plate thickness on the basis of excitation and nonexcitation of the electromagnet block (not shown) is brought in and out of contact alternately with the fixed contacts **21***a* and **23***a* or the fixed contacts **23***b* and **22***a,* thereby opening and closing the contact.

Although the present embodiment has been described on the basis of the case where the insulating wall **18** is formed separately from the base **10**. However, the present invention is not always limited to this, and the insulating wall may be integrally formed with the base **10**.

A fourth embodiment is as shown in FIG. **16** through FIG. **18**, in which movable contactors **51***b* and **52***b* are arranged in line with each other. Due to this arrangement, the insulating walls **14**, **15**, **16** and **17** of the base **10** are projecting in correspondence with a shield plate **24** bent roughly in the middle portion thereof.

According to the present embodiment, the two movable contactors **51***b* and **52***b* are arranged in line with each other. This arrangement has the advantage that the manufacturing can be facilitated to allow a movable block having a high dimensional accuracy to be manufactured and allow the prevention of the occurrence of a variation in operation characteristics. The other part is similar to that of the aforementioned embodiment, and therefore, no description is provided therefor.

FIRST EXPERIMENTAL EXAMPLE

The high-frequency use switch having the shield structure described in connection with the first embodiment was measured with regard to its high-frequency characteristic in the case where the contact circuit corresponding to the movable contactor **51***b* was opened and in the case where the contact circuit was closed. The measurement results are shown in FIG. **19** and FIG. **20**.

PRIOR ART EXAMPLE

The high-frequency use switch described in connection with the prior art was measured similar to the first experimental example with regard to its high-frequency characteristic in the case where the contact circuit corresponding to the movable contactor was opened and in the case where the contact circuit was closed. The measurement results are shown in FIG. **19** and FIG. **20**.

As is apparent from FIG. **19**, it can be found that the present first experimental example is always superior with regard to the high-frequency characteristic in the case where the contact is opened. The difference is remarkable particularly above 2000 MHz.

As is also apparent from FIG. **20**, it can be found that the present first experimental example is always superior with regard to the high-frequency characteristic in the case where the contact is closed. The difference is remarkable particularly above 2000 MHz.

This can be considered to be ascribed to the fact that impedance matching can be attained almost throughout the entire range in the first experimental example as compared with the fact that impedance matching can be attained only partially in the prior art.

The dielectric positioned on the back surface of the fixed contact is not always required to be an insulating wall projecting from the base and is allowed to be a coating film or a sheet, which is made of a dielectric material and is laminated on the side surface of the shield plate.

As shown in FIG. **21** through FIG. **24**, a high-frequency use switch according to a fifth embodiment is constructed roughly of a base **110**, a fixed contact mechanism **120**, an electromagnet block **130**, an armature **140**, a movable block **150** and a casing **160**.

The base **110** is provided with support walls **112** and **113** that project at the corner portions on the opposite sides of a flat base body **111** made of a dielectric (synthetic resin) and terminal holes for arranging a fixed contact block **120** described later between them. Upper end portions of the support walls **112** and **113** are formed with bearing grooves **112***a* and **113***a,* respectively, for pivotally supporting the movable block **150** described later. A base portion of the support wall **113** is formed with a positioning use projecting portion **114** provided with an arc surface that serves as a pivot support of the armature **140** described later.

The fixed contact block **120** is constructed of identically-shaped fixed contact terminals **121** and **122** having fixed contacts **121***a* and **122***a,* respectively, a common fixed contact terminal **123** having fixed contacts **123***a* and **123***b* and a shield plate **24**, which are integrally formed with a retainer **120***a* made of a synthetic resin, or a dielectric.

In particular, the fixed contact **121***a* and the common fixed contact **123***a* constitute a normally-open fixed contact mechanism, while the fixed contact **122***a* and the common fixed contact **123***b* constitute a normally-closed fixed contact mechanism.

The shield plate **124** is formed by punching a plate-shaped conductive material into a specified shape and press-processing the same. Then, the shield plate **124** has a plurality of ground terminals **125** projecting in line with one another on the lower side and ground tongues **126***a* and **126***b* formed by inwardly bending extended both end portions. Further, an engagement pawl **127** to be engaged with a restoration spring **156** for the movable block **150**, described later, is projecting from an upper edge portion of the shield plate **124**.

Therefore, by positioning the upper end portions of the fixed contact terminals **121** and **122** and the common fixed contact terminal **123** in cut portions provided on the lower side of the shield plate **124** and thereafter integrally forming these members with the retainer **120***a,* the fixed contacts **121***a* and **122***a* and the common fixed contacts **123***a* and **123***b* are exposed sideward. Further, as shown in FIG. **24**, the fixed contacts **121***a* and **122***a* of the fixed contact terminals **121** and **122**, the fixed contacts **123***a* and **123***b* of the common fixed contact terminal **123** and the shield plate **124** are arranged roughly in line with one another via the retainer **120***a*. With this arrangement, the so-called coplanar guide structure is obtained.

Then, the fixed contact block **120** is assembled by press-fitting its fixed contact terminals **121** and **122**, the lower end portion of the common fixed contact terminal **123** and the ground terminal **125** of the shield plate **124** into the terminal holes of the base **110**.

The electromagnet block **130** is formed by inserting an iron core **133** having a roughly T-figured section shape into a center hole **132***a* of a spool **132** around which a coil **131** is wound. The one end portion projecting from the center hole **132***a* is made to serve as a magnetic pole piece **133***a,* while the projecting other end portion **133***b* is fixed in a caulking manner to one end portion of a yoke **134** bent roughly in an L-figured shape. Coil terminals **135** are press-fit into flange portions **132***b* of the spool **132**, and a lead wire of the coil **131** is wound around and soldered- to this.

Then, by press-fitting the coil terminals **135** into terminal holes **111***a* of the base **110**, the electromagnet block **130** is positioned in the specified position.

The armature **140** is made of magnetic material and bent roughly in an L-figured shape, and its one end portion is formed into a narrowed portion **141**.

The armature **140** is assembled from above along the positioning use projecting portion **114** that is projecting from the upper surface of the base. Therefore, the armature **140** is pivotally supported on the inner surface of the positioning use projecting portion **114** used as a support, and its one end portion **142** can abut against the magnetic pole piece **133***a* of the iron core **133**.

The movable block **150** is made of a pair of movable bases **151** and **152** having an identical shape and a restoration spring **156**.

The movable bases **151** and **152** are constructed so that movable contactors **151***b* and **152***b* are insert-molded into the lower end portions of projecting bars **151***a* and **152***a* extended downward from the side surfaces. The movable bases **151** and **152** have shaft portions **153** that project laterally from their one side end portions as well as engagement use projecting portions **154** that project laterally from their other side end portions.

The shaft portions **153** have an escape formed with flat surfaces **153***a* and **153***b* that are vertically parallel to each other. Further, a burr that cannot be avoided in the resin forming process is generated on the flat surfaces **153***a* and **153***b,* thereby allowing a smooth pivoting operation to be obtained.

The base portion of the engagement use projecting portion **154** is formed with a recess portion **155** to be engaged therewith. Further, the projecting portion **154** is formed with a projection **154***a* to be press-fit into the through hole **155***a* formed in a recess portion **155** for the engagement.

Then, the projecting portion **154** of the movable base **151** is positioned while being fit in the recess portion **155** of the

movable base **152**. Then, the projection **154***a* and the through hole **155***a* of the movable base **151** are press-fit on the through hole **155***a* and the projection **154***a* of the movable base **152**, temporarily fixed and thereafter connected and integrated with each other by adhesive, high-frequency welding or other means.

Further, by mounting a gripping portion **157** of the restoration spring **156** on the upper edge portions of the movable bases **151** and **152** that have been connected and integrated with each other, the movable block **150** is completed.

According to the present embodiment, the movable bases **151** and **152** having the identical shape are used, and accordingly, there is the advantage that the resin molding is simplified and the manufacturing of the metal mold can be facilitated.

Then, the shaft portions **153** and **153** of the movable block **150** are fit into the bearing grooves **112***a* and **113***a* of the base **110**, thereby pivotally supporting the movable block **150** in the direction of thickness. With this arrangement, the movable contactor **151***b* faces the fixed contacts **121***a* and **123***a* or the ground tongue **126***a* while being able to come into and out of contact alternately with them. On the other hand, the movable contactor **152***b* faces the fixed contacts **122***a* and **123***b* or the ground tongue **126**b while being able to come into and out of contact alternately with them. Then, the tip portion of the restoration spring **156** is engaged with the engagement pawl **127** of the shield plate **124**, thereby urging the movable block **150** toward the electromagnet block **130** side.

The casing **160** has a box-like shape that can fit on the base **110**, and portions that belong to its ceiling surface and are located just above the shaft portions **153** of the movable block **150** are provided with a positioning use projecting portion **161** for preventing a lift (see FIG. **22**).

When the casing **160** is fit on the base **110** integrated with the internal components, the positioning use projecting portion **161** faces the flat surface **153***a* of the shaft portion **153** with a minute gap retained between them. Then, by sealing the contact surface of the base **110** and the casing **160** with a sealant, the assembling work is completed.

The operation of the high-frequency use switch having the aforementioned construction will be described next.

When no voltage is applied to the coil **131** of the electromagnet block **130**, the movable block **150** is urged toward the electromagnet block **130** side by a spring force of the restoration spring **156**. Then, the movable contactor **151***b* is put in contact with the ground tongue **126***a*, while the movable contactor **152***b* is put in contact with the fixed contacts **123***b* and **122***a*.

When a voltage is applied to the coil **131** for the excitation, the one end portion **142** of the armature **141** is attracted to the magnetic pole piece **133***a* of the iron core **133**. By this operation, the armature **140** pivots to make its narrowed portion **141** press the movable block **150** outward against the spring force of the restoration spring **156**. Consequently, the movable block **150** pivots around the shaft portions **153**, and the movable contactor **151***b* separates from the ground tongue **126***a* and comes into contact with the fixed contacts **121***a* and **123***a*. On the other hand, the movable contactor **152***b* separates from the fixed contacts **123***b* and **122***a* and comes into contact with the ground tongue **126***b*. Thereafter, the one end portion **142** of the armature **140** is attracted to the magnetic pole piece **133***a* of the iron core **133**.

Subsequently, if the application of the voltage to the coil **131** is stopped, then the movable block **150** pivots in the direction opposite to the pivotal direction by the spring force of the restoration spring **156**. By this operation, the movable contactor **151***b* comes into contact with the ground tongue **126***a*, and the movable contactor **152***b* comes into contact with the fixed contacts **123***b* and **122***a*, achieving restoration into the original state.

A sixth embodiment is as shown in FIG. **25** through FIG. **28**B, in which the retainer **120***a* is integrally formed with the fixed contact terminals **121** and **122** integrally cut out of a lead frame **124***a*, the common fixed contact terminal **123** and the shield plate **124** (see FIG. **26**). A shoulder portion **120***b* that serves as a reference in bending the ground tongues **126***a* and **126***b* extends from one end portion of this retainer **120***a*.

According to the present embodiment, the shoulder portion **120***b* serves as a reference in bending the ground tongues **126***a* and **126***b*. This arrangement has the advantage that the bending work of the ground-tongues **126***a* and **126***b* can be performed correctly and speedily.

Therefore, according to the present embodiment, the fixed contact terminals **121** and **122**, the common fixed contact terminal **123** and the shield plate **124** are cut out of the lead frame **124***a*, and thereafter the retainer **120***a* is integrally formed. Then, by separating the fixed contact terminals **121** and **122** and the shield plate **124** from the lead frame **124***a* and thereafter bending the ground tongues **126***a* and **126***b*, the fixed contact block **120** is completed. The other part is similar to that of the aforementioned first embodiment, and therefore, no description is provided therefor.

In contrast to the aforementioned fifth and sixth embodiments in which the movable block **150** is pivotally supported by the support walls **112** and **113** that are integrally formed with the base **110**, a seventh embodiment is as shown in FIG. **29** through FIG. **33**, in which support flaps **128** and **129** extend from both end portions of the shield plate **124** that is arranged upright while being press-fit into the base **10** and the shaft portions **153** and **153** of the aforementioned movable block **150** are pivotally supported while being inserted in bearing holes **128***a* and **129***a* provided for the support flaps **128** and **129**.

As shown in FIG. **30**, similar to the aforementioned fifth and sixth embodiments, the fixed contacts **121***a* and **122***a* and the fixed contacts **123***a* and **123***b* are arranged roughly in line with the shield plate **124**, constituting a coplanar guide structure in the present embodiment.

It is to be noted that the shield plate **124** has an engagement pawl **127** which is laterally extended from its support flap **128** and with which the free end portion of the restoration spring **156** is engaged. Further, the shield plate **124** has positioning tongues **129***b* which are laterally extended from the other support flap **29** and are brought in pressure contact with the bent corner portion of the armature **140** so as to pivotally support the armature.

Therefore, similar to the aforementioned sixth embodiment, the retainer **120***a* is integrally formed with the fixed contact terminals **121** and **122**, the common fixed contact terminal **123** and the shield plate **124** cut out of a lead frame (not shown). Subsequently, by separating the fixed contact terminals **121** and **122** and so on from the lead frame, the fixed contact block **120** is obtained. Further, the fixed contact terminals **121** and **122** of this fixed contact block **120**, the lower end portion of the common fixed contact terminal **123** and the ground terminals **125** of the shield plate **124** are press-fit into the base **110** to be assembled therewith. The other part is almost similar to that of the aforementioned first embodiment, and therefore, no description is provided therefor.

SECOND EXPERIMENTAL EXAMPLE

The high-frequency use switch having the shield structure described in connection with the fifth embodiment was measured with regard to its high-frequency characteristic in the case where the contact circuit corresponding to the movable contactor **51***b* was opened and in the case where the contact circuit was closed. The measurement results are shown in FIG. **34** and FIG. **35**.

PRIOR ART EXAMPLE

The high-frequency use switch described in connection with the prior art was measured similar to the second experimental example with regard to its high-frequency characteristic in the case where the contact circuit corresponding to the movable contactor was opened and in the case where the contact circuit was closed. The measurement results are shown in FIG. **34** and FIG. **35**.

As is apparent from FIG. **34**, it can be found that the present second experimental example is always superior with regard to the high-frequency characteristic in the case where the contact is opened. The difference is remarkable particularly above 2000 MHz.

As is also apparent from FIG. **35**, it can be found that the present second experimental example is always superior with regard to the high-frequency characteristic in the case where the contact is closed. The difference is remarkable particularly above 2000 MHz.

This can be considered to be ascribed to the fact that impedance matching can be attained almost throughout the entire range in the second experimental example as compared with the fact that impedance matching can be attained only partially in the prior art.

The retainer **120***a* of the fixed contact block **120** is not always required-to be separated from the base **110** and is, of course, allowed to be integrally formed with the base **110**.

INDUSTRIAL APPLICABILITY

The present invention can be applied not only to the high-frequency use switches of the aforementioned embodiments but also to the high-frequency use switches of other high-frequency use switches.

What is claimed is:

1. A high-frequency switch, wherein a pair of movable contacts that reciprocate in a direction of thickness thereof on a basis of excitation and nonexcitation of an electromagnetic block have end portions, both of the end portions of each movable contact are brought in and out of contact alternately with a normally-open common fixed contact and a normally-open fixed contact and with a normally-closed common fixed contact and a normally-closed fixed contact to open and close different high-frequency current circuits; and

wherein the pair of movable contacts are arranged in parallel so as not to face each other, the normally-open common fixed contact and the normally-closed common fixed contact extend in opposite directions, and dielectrics, made of insulating walls molded integral with a base, are respectively arranged between the normally-open common fixed contact and the normally-open fixed contact, and a normally-open shield member, and between the normally-closed common fixed contact and the normally-closed fixed contact, and a normally-closed shield member.

2. A high frequency switch, wherein a pair of movable contacts that reciprocate in a direction of thickness thereof on a basis of excitation and nonexcitation of an electromagnet block have end portions, both of the end portions of each movable contact are brought in and out of contact alternately with a normally-open common fixed contact and a normally-open fixed contact and with a normally-closed common fixed contact and a normally-closed fixed contact to open and close different high-frequency current circuits; and

wherein the pair of movable contacts are arranged in parallel so as not to face each other, the normally-open common fixed contact and the normally-closed common fixed contact extend in a same direction so as to be integral with each other, and a dielectric made of a molded insulating material is arranged between the normally-open common fixed contact, the normally-closed common fixed contact, the normally open fixed contact and the normally closed fixed contact, and a shield member.

3. A high-frequency switch, wherein a pair of movable contacts that reciprocate in a direction of thickness thereof on a basis of excitation and nonexcitation of an electromagnet block have end portions, both of the end portions of each movable contact are brought in and out of contact alternately with a normally-open common fixed contact and a normally-open fixed contact and with a normally-closed common fixed contact and a normally-closed fixed contact to open and close different high-frequency current circuits; and

wherein the pair of movable contacts are arranged in line with one another in an insulated state, the normally-open common fixed contact and the normally-closed common fixed contact extend in opposite directions, and dielectrics made of a insulating walls, which are molded integral with a base, are respectively arranged between the normally-open common fixed contact and the normally-open fixed contact, and a normally-open shield member, and between the normally-closed common fixed contact and the normally-closed fixed contact, and a normally-closed shield member.

4. A high-frequency switch as claimed in claim **2**, wherein the dielectric is constructed of at least a pair of insulating walls arranged parallel to each other with a distance between each pair adjacent insulating walls equal to a thickness of the shield member.

5. A high-frequency switch as claimed in claim **1**, wherein a lower end portion of a fixed contact terminal provided with the fixed contact and a lower end portion of a ground terminal extended from the shield member are arranged in line with each other.

6. A high-frequency switch as claimed in claim **2**, wherein a ground tongue extending on the shield member and with which the movable contact comes in contact when separated from the fixed contacts.

7. A high-frequency switch as claimed in claim **1**, further comprising

an engagement pawl engaging a restoration spring and extending on the shield member, the restoration spring biasing the movable contact.

8. A high-frequency switch, wherein a pair of movable contacts that reciprocate in a direction of thickness thereof on a basis of excitation and nonexcitation of an electromagnet block have end portions, both of the end portions of each movable contact are brought in and out of contact alternately with a normally-open common fixed contact and a normally-open fixed contact and with a normally-closed common fixed contact and a normally-closed fixed contact to open and close different high-frequency current circuits; and

wherein the pair of movable contacts are arranged in parallel so as not to face each other, the normally-open

common fixed contact and the normally-closed common fixed contact extend in opposite directions; a normally-open shield member is arranged between the normally-open common fixed contact and the normally-open fixed contact, a normally-closed shield member is arranged between the normally-closed common fixed contact and the normally-closed fixed contact, and dielectrics made of insulating walls, which are molded integral with a base or the shield member, are respectively arranged between the fixed contacts and the shield member.

9. A high-frequency switch, wherein a pair of movable contacts that reciprocate in a direction of thickness thereof on a basis of excitation and nonexcitation of an electromagnet block have end portions, both of the end portions of each movable contact are brought in and out of contact alternately with a normally-open common fixed contact and a normally-open fixed contact and with a normally-closed common fixed contact and a normally-closed fixed contact to open and close different high-frequency current circuits; and

wherein the pair of movable contacts are arranged in parallel so as not to face each other, the normally-open common fixed contact and the normally-closed common fixed contact extend in opposite directions, a normally-open shield member is arranged between the normally-open common fixed contact and the normally-open fixed contact, a normally-closed shield member is arranged between the normally-closed common fixed contact and the normally-closed fixed contact, and dielectrics made of a insulating walls, which are molded integral with a base or the shield member, are respectively arranged on a side surface of the normally-open common fixed contact, the normally-closed common fixed contact, and the normally-open shield member, and on a side surface of the normally-closed common fixed contact, the normally-closed fixed contact and the normally-closed shield member.

10. A high-frequency switch as claimed in claim **8**, wherein

a ground tongue extending from at least one end portion of a shield member and with which the movable contact that is separated from the fixed contacts comes in contact.

11. A high-frequency switch as claimed in claim **9**, wherein

a bending shoulder portion is integrally formed with a base portion of a ground tongue.

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